March 2016/Jumada Al-Awwal, 1437
Volume 7, Issue No. 6

جامعة الملك عبدالله للعلوم والتقنية
ثول، المملكة العربية السعودية
King Abdullah University of Science and Technology
Thuwal, Kingdom of Saudi Arabia

The المنارة Beacon

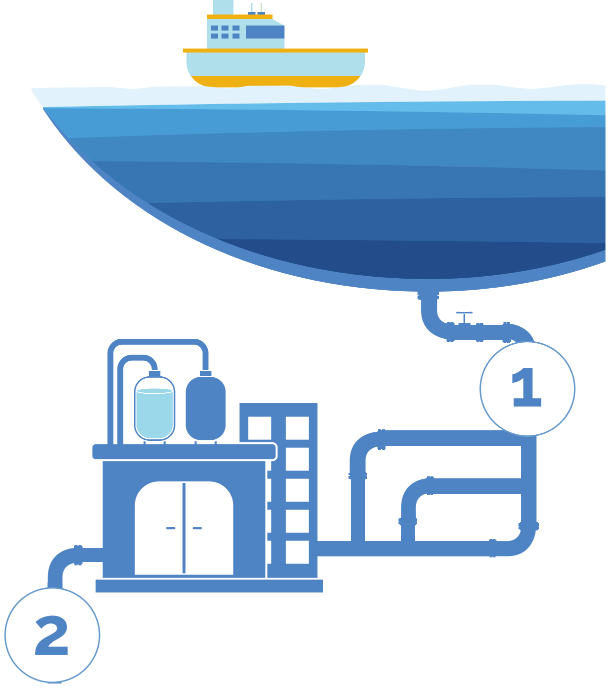
www.kaust.edu.sa

خريجو جامعة الملك عبدالله في ريادة أبحاث الروبوتات

KAUST graduates lead the way in robotics research

Page 6

The KAUST hydrologic cycle
Page 10



Mohamed-Slim Alouini honored by the Institute of Electrical and Electronics Engineers
Page 4

The future of living—the house that algae built
Page 12

Paper skin sensors for environmental monitoring
Page 14

Reality check for Red Sea wave predictions
Page 16

Relax! High-resolution imaging reveals atomic structure of an important plant stress factor
Page 20

Editor's note

Water. We drink it, cook and clean with it and use it in the manufacture of nearly everything. Nothing is more vital to our existence—nothing is more central to life on our planet.

Water is one of our University's four main research thrusts. The Water Desalination and Reuse Center is focused on the development of new and optimized methods for low-energy water desalination and water reuse. The Red Sea Research Center is dedicated to understanding the stress experienced by marine ecosystems caused by overfishing, coastal development, global climate change and more. The Advanced Membranes and Porous Materials Research Center studies the production of potable and industrial water.

This issue of The Beacon hints at just a fraction of the knowledge our institution holds and generates about water. We've highlighted a few examples we hope you'll find engaging. We explore how water is collected, purified, consumed and recycled in our community. We look to experts on campus to see some of the latest water-related research, and we go beneath the waves with some of our marine scientists to explore what clues the Red Sea holds to adaptation in the global oceans to changes in climate.●

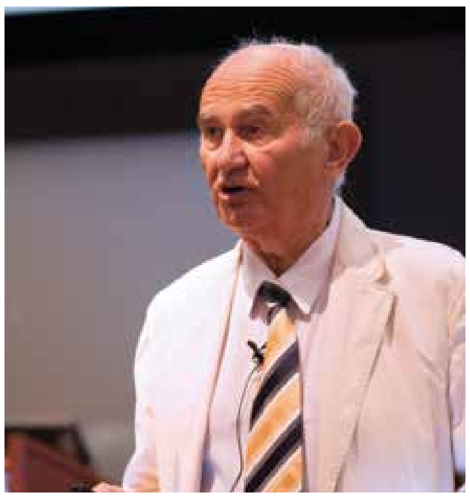
The Beacon
Volume 7 , Issue No. 6

PUBLISHED BY MARKETING COMMUNICATIONS
King Abdullah University of Science and Technology
Thuwal, Kingdom of Saudi Arabia

The Beacon Staff
Managing Editor: Nicholas Demille
Arabic Editor: Salah Sindi
English Editor: Caitlin Clark
Design Lead: Hazim Alradadi
Designer: Mahjubeh R. Mashhadi
Writers: Diane Burgoyne, David Murphy, Meres J. Weche
Translator: Adel Alrefaie
Photographer: Ginger Lisanti

The Beacon is published monthly.

© King Abdullah University of Science and Technology



In brief

Members of the KAUST research community and external industry partners and Saudi universities attended the recent KAUST Catalysis Center **(KCC) symposium** entitled **"Catalysis for Artificial Photosynthesis,"** which ran from February 1 to 3. KAUST speakers included Kazuhiro Takanabe, Jean-Marie Basset and Omar Mohammed. For more information, **visit www.kaust.edu.sa/events/kcc-2016.**

On **February 7 through 9,** KAUST representatives attended the **2016 Saudi Water and Electricity Forum** in Riyadh. Speakers included Managing Director of KAUST Solar & Photovoltaics Engineering Research Center **Marc Vermeersch** and Deputy Vice President for Innovation & Economic Development **Tristan Walker.**

On **February 17**, the KAUST community enjoyed a **Sci-Café** featuring **Professors Charlotte Hauser, Husam Alshareef and Lance Li**. The interactive discussion between KAUST scientists and community members addressed the question "how do we innovate materials?" The event was moderated by Gordon McConnell, manager of the University's Entrepreneurship Center.

On **Wednesday, February 24**, Boeing, in collaboration with the KAUST Industry Engagement Office, held a panel discussion to celebrate the **"Global Day of the Engineer."** The panel, which included Dr. Naveed Hussain, Boeing vice president of aeromechanics technology, Dr. William Lyons, Boeing director of global technology, and Professor William L. Roberts, director of the Clean Combustion Research Center at KAUST, discussed the important roles of scientists and engineers and the amazing innovations they create.

On **February 24 and 25**, KAUST welcomed representatives from the University's industrial and scientific partners to the campus for the seventh annual **KAUST Industry Advisory Board** (KIAB) meeting.

Keynote speakers and delegates from academia, governmental laboratories and industry will attend the **2016 Future Fuels Workshop** organized by the Clean Combustion Research Center (CCRC) from **March 7 to 9**. The workshop will encompass a wide spectrum of cutting-edge technologies relevant to fuel production, utilization and global sustainability, with an emphasis on low-grade and alternative fuels for transportation and stationary power sectors.

KAUST and the U.S. National Science Foundation (NSF) have jointly organized a conference taking place from **March 14 to 16**. The event will assemble leading subject matter authorities on **electronic materials, devices and systems for a sustainable future**, and has been organized by **Muhammad Mustafa Hussain**, associate professor of electrical engineering, with financial support from the KAUST Office of Sponsored Research and co-sponsored by NSF, KAUST Industry Collaboration Program and CEMSE.

The Industry Engagement Office, in collaboration with Graduate Affairs and Saudi Initiatives, will host its seventh annual KICP career day on **Thursday, March 17, from 1:30 to 4:30 p.m. in the Museum and Conference Center (bldg. 19).** For more information, visit **https://kaust.collegiatelink.net/organization/KICP_2016.**

The **2016 Spring Enrichment Program** will take place from **April 22 to 30**. This year's theme is "Exploring Innovation." Stay tuned to **http://thelens.edu.sa** for complete event information.

The **Seventh Annual Talent Show** will be held on **Thursday, April 28** in the Auditorium (bldg. 20) from 7:00 to 9:15 p.m. Preliminary auditions for the Talent Show will be held in the Al-Khawarizimi (bldg. 1) multipurpose room on Sunday, April 10 from 5:30 to 8:30 p.m. An online registration form will be available from Sunday, March 13 onward on the Arts Office website.

KAUST community members are invited to submit original works of art for display in the University Library as part of the **Artists of KAUST 2016 Exhibit**. The exhibition will open with a reception on **Wednesday, April 20** and will run until **Tuesday, May 3**. Creators of paintings, photography, textiles, jewelry, sculpture and ceramics are all welcome to apply. The event is sponsored by the Office of the Arts, in collaboration with the University Library.

Faculty and research scientists are invited to participate in the **2016 Saudi Research Science Institute (SRSI)**, a summer research internship program for academically talented high school students. SRSI 2016 will run from **July 16 to August 27**. Prospective mentors must offer suitable five-week projects in the science, technology, engineering and math (STEM) fields that give the students a chance to experience research at KAUST. For more information, contact srsi@kaust.edu.sa.●

Accolades

1

2

---

1. Mohamed-Slim Alouini is KAUST professor of electrical engineering and associate dean of the University's Computer, Electrical and Mathematical Science and Engineering Division.

2. KAUST Ph.D. student Luca Fortunato won best oral presentation award at the 8th International Desalination Workshop in South Korea in late 2015.

3. Jean-Luc Bredas, KAUST distinguished professor and director of the Solar and Photovoltaic Engineering Research Center (SPERC), will attend the 251st American Chemical Society (ACS) National Meeting in March to receive a 2016 ACS Award in the Chemistry of Materials.

Mohamed-Slim Alouini honored by the Institute of Electrical and Electronics Engineers

Mohamed-Slim Alouini, KAUST professor of electrical engineering and associate dean of the University's Computer, Electrical and Mathematical Science and Engineering Division, has been honored as a 2016 Distinguished Lecturer by the Institute of Electrical and Electronics Engineers (IEEE) Communications Society. He was honored along with a diverse group of global academic leaders for addressing spectrum scarcity through optical wireless communications and pushing the envelope of wireless sensor networks.

IEEE Distinguished Lecturers are engineering professionals who lead their fields in new technical developments that help shape the global community. The experts specialize in the field of interest of their society or council, and as a result of their designation, they travel to various technical and regional groups, such as society and technical council chapters, to give lectures on their respective areas of specialty.

Alouini received his Ph.D. in electrical engineering from the California Institute of Technology (Caltech) in 1998. He served as a faculty member at the University of Minnesota and at Texas A&M University in Qatar before joining KAUST in 2009. Alouini currently leads the Communication Theory Lab, where he heads research into the modeling, design and performance analysis of wireless communication systems. Visit https://ctl.kaust.edu.sa to learn more about Alouini and his team's work.●

Ph.D. student honored at Korean International Desalination Workshop

KAUST Ph.D. student Luca Fortunato from the University's Water Desalination and Reuse Center (WDRC) won best oral presentation award at the 8th International Desalination Workshop (IDW) in November 2015 in Jeju, South Korea.

Fortunato's presentation was entitled "A novel approach for spatially-resolved quantification of biofouling in membrane systems using optical coherence tomography (OCT) and 3D image analysis." He is advised by KAUST Professor TorOve Leiknes, director of the WDRC.

"The IDW was initiated a number of years ago by one of the key research groups working on desalination in Korea, and is a major conference event in the desalination field," Leiknes said. "Since the inauguration of the WDRC, we have had a close collaboration with desalination colleagues in Korea. A key area of our research is membrane biofouling, a challenge in all membrane filtration systems. Luca's excellent presentation focused on fundamental studies of biofouling and impressed and engaged the IDW research community."

"It was a great honor for me to receive the award for the novelty of my research," Fortunato stated. "I came to KAUST two years ago from Italy, and my experience here has been nothing but positive. KAUST gives me the opportunity to meet and discuss my research with people from different backgrounds from all over the world—this opens the mind and allows for the development of multidisciplinary projects."●

3

Jean-Luc Bredas receives American Chemical Society Award in the Chemistry of Materials

Jean-Luc Bredas, KAUST distinguished professor and director of the University's Solar and Photovoltaic Engineering Research Center (SPERC), will receive a 2016 American Chemical Society (ACS) Award in the Chemistry of Materials at the 251st ACS National Meeting in San Diego, California (U.S.) on March 15, 2016.

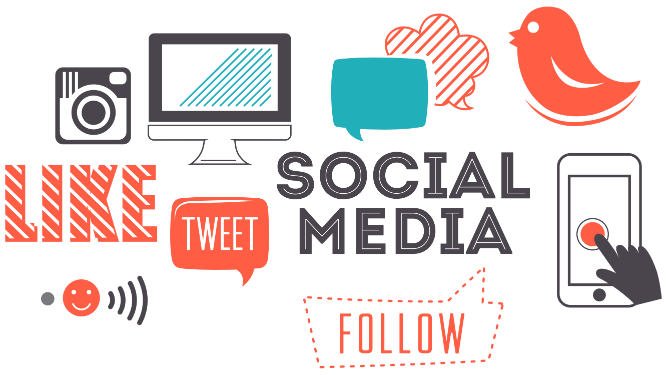
Bredas was appointed as director of SPERC in January 2014, and has conducted groundbreaking theoretical research into new organic materials that can be exploited for novel generation of devices based on organics used as semiconductors. His research group at KAUST aims to understand the electronic and optical properties of these promising organic materials, with a focus on applications in the fields of electronics, photonics and information technology.

The ACS award is sponsored by the American chemical company E. I. du Pont de Nemours & Co. (DuPont). It was established by the company in 1988 to commemorate the 50th anniversary of the commercialization of nylon and the discovery of Teflon, and also recognizes outstanding achievements in the field of the chemistry of materials. Considerable emphasis is also placed on nominees' work as mentors and colleagues to their fellow researchers.

The ACS National Meeting & Exposition aims to give a greater understanding of the role chemistry plays in global health and safety, the economy and the environment, and provides the opportunity for attendees to share ideas with leading experts in the field.●

Let's get social:

/KaustOfficial
@KAUST_News
/kaustedu
kaustofficial
kaustofficial

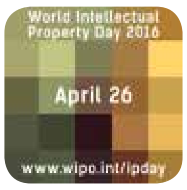


Here's a roundup of **KAUST-related** content on the web

#WomenInSTEM - In early February, we joined the global community in celebrating our female scientists—here is one of the ways KAUST contributed to the global conversation. **http://goo.gl/8rGYWb**

#EngineersWeek - In late February, KAUST celebrated the impact engineers have on science, research and everyday life. Read about a team of KAUST alumni building robots for Saudi Aramco. **http://buff.ly/1oGnBqr**

#SciCafeKAUST - How do we innovate supercomputing, fuels, materials and more? Keep track of this hashtag to find out, and remember that the next Sci-Cafe event takes place on March 23.



#WorldIPDay - Intellectual property rights are the cornerstone of innovation. This year's observance of World Intellectual Property Day is April 26. Follow this hashtag for KAUST-related content and to see how creativity is being protected and reimagined around the world.

KAUST graduates lead the way in robotics research

By David Murphy and Caitlin Clark

In 18 months from September 2012 to February 2014, the KAUST-based Saudi Aramco Intelligent Systems Team—all graduates of the University—designed and built a robotic crawler that can conduct visual and ultrasonic inspection of Aramco's steel operational assets and sense gas. The robot is operated wirelessly, can move on curved surfaces and is compact and self-contained—it is an intelligent system capable of detecting steel thinning caused by corrosion in tanks, vessels, pipes and other difficult-to-access locations.

Developing the robotic inspection crawler from a pencil drawing to a fully functional prototype in such a short time was an industry first, winning the then eight-member team the Industry Glory Medal from the International Federation of Inventors Association in 2013.

Saudi Aramco's R&D management envisioned the team of KAUST graduates working together on the University's campus as an opportunity to boost both their performance and development; strengthen ties between academia and industry; and leverage the rapid development of robotic technology.

The Beacon sat down with Pablo Carrasco Zanini, a KAUST graduate in mechanical engineering and current unit head of the Intelligent Systems Team. Carrasco Zanini outlined the process of developing the new technology and the excitement it generated among the multinational and multi-disciplinary team.

The Beacon: What brought you to KAUST to study mechanical engineering?

Carrasco Zanini: Towards the end of my undergraduate program in mechatronics engineering in Mexico, I was looking for exciting opportunities to pursue a master's degree, and I stumbled upon the KAUST program. It matched my requirements and seemed a great opportunity to work in world-class facilities with an international group of people. I applied and was accepted to the scholarship program, joining KAUST with the University's second class of students in 2010.

The Beacon: Describe the Intelligent Systems Team and Saudi Aramco's R&D Center at KAUST in more detail.

Carrasco Zanini: The Intelligent Systems Team is a multidisciplinary team of research engineers from 10 different countries. We operate under Saudi Aramco's Research & Development Center, Oil & Gas Network Integrity Division, and we are permanently based at our Satellite Research Center in KAUST.

As a team, we focus on identifying operational challenges across the energy and chemicals sectors that can be addressed by developing novel robotic technologies following a business-driven, rapid development approach.

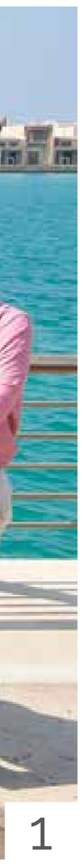
The Beacon: How would you best describe your research and the goals behind it?

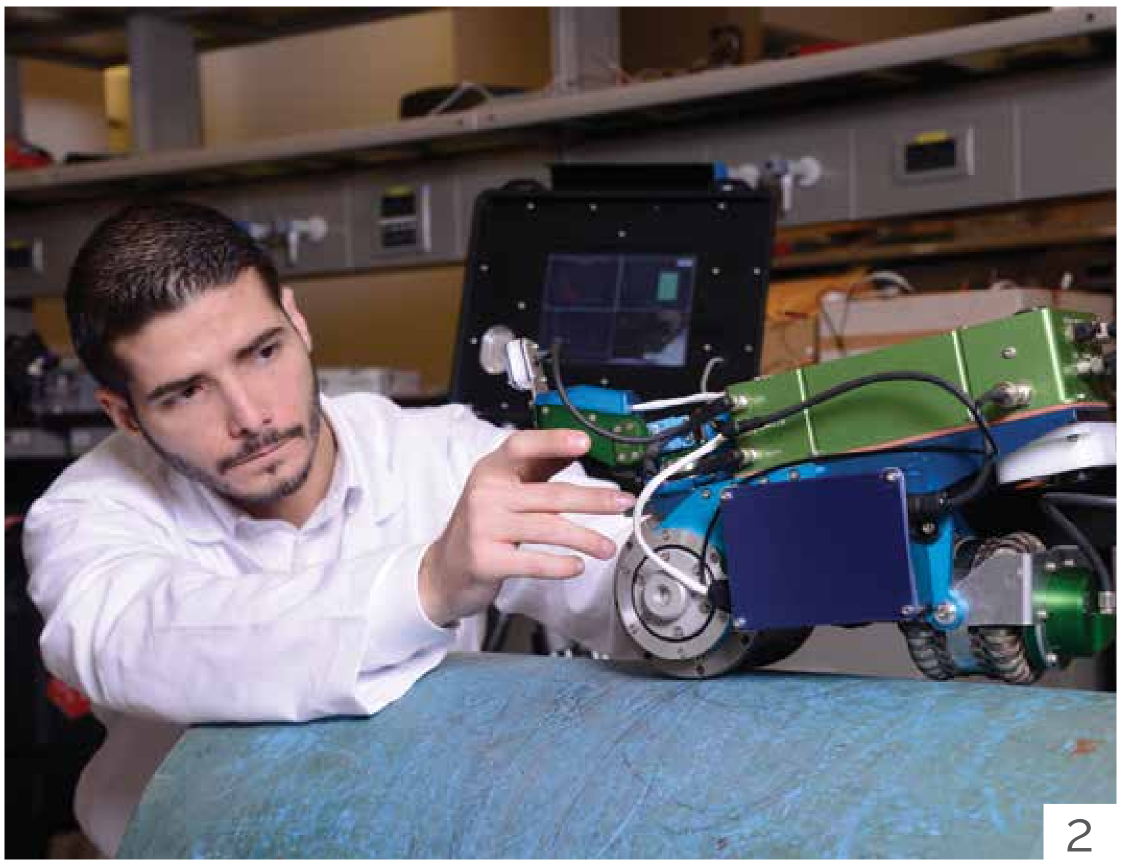
Carrasco Zanini: If I had to pick a word to describe our research, I would pick "exciting." There is always something exciting going on in our lab—maybe a new piece of software, a new printed circuit board or a new robotic prototype crawling around while under test—basically, there is always something "cooking." Robotics as a field of research is often that way, especially when you have passionate researchers behind the wheel.

The team primarily concentrates on solving Aramco's challenges and addressing the company's needs, but we also try to create value in the Kingdom's economy as much as synergies with this permit.

The Beacon: Describe the inception and development of the robotic crawler.

Carrasco Zanini: We are certainly proud of how far we've come with the Saudi Aramco Inspection Robot, or SAIR, as we call it. The idea originated from a combination of understanding both the customer's needs as well as the state-of-the-art commercially available technologies, including their benefits and shortcomings.


1


2

1. Members of the Saudi Aramco Intelligent Systems Team (from L to R) at KAUST: Fernando Diaz, Sahejad Patel, Fadl Abdellatif, Abdulaziz Shahrani, Ali Outa, Hassane Trigui, Hamad Al Saiari, Pablo Carrasco Zanini, Brian Parrott, Ayman Amer, Ali Al Shehri and Ameen Al Obedan. Photo courtesy of Saudi Aramco.

2. Pablo Carrasco Zanini, unit head of the KAUST-based Saudi Aramco Intelligent Systems Team and a 2011 KAUST master's degree graduate, works in the lab on one of Aramco's robotic crawlers. Photo courtesy of Saudi Aramco.

3. A robotic crawler produced by the Saudi Aramco Intelligent Systems Team on display in the field. Photo courtesy of Saudi Aramco.

We knew that our operation would find great benefit in minimizing the expenses and hazards associated with erecting scaffolding for the inspection of elevated or hard-to-reach structures, and it appeared that no commercially available technology could offer the right combination of functionalities and features for the job.

We targeted three main features: have the robot operate wirelessly; achieve a high level of maneuverability on different kinds of curved surfaces; and have the ability to run various kinds of inspection with the same device. Our idea went from a sketch on a piece of paper to a field-tested prototype in about a year and a half.

The Beacon: How is your team's research addressing current and future challenges related to the Kingdom's energy industry and building a knowledge-based economy?

Carrasco Zanini: As a part of Aramco's Oil & Gas Network Integrity Division, we focus on projects that directly impact our ability to sustain reliable operations; for example, preventing failures and shutdowns due to loss of integrity in our pipelines. Inspection for corrosion is a subject of great interest in this context, and we address this for on-shore and underwater assets.

At the same time, we keep an eye open for opportunities where robotics may assist in promoting growth in the Kingdom's economy, and in particular in the energy sector, where we believe that renewable energies—including solar energy—is an area where robotics will play an important role.

The Beacon: Where do you envision your type of research is headed in the future?

Carrasco Zanini: We believe we'll continue to push the boundaries of robotics applications in the energy and chemicals sectors, tackling more and more challenging tasks—for example, moving from inspection and monitoring to repair and maintenance, introducing higher levels of autonomy or developing solutions for harsh environments. We want to make sure our team is seen as a serious player in the field of robotics.

The Beacon: How did KAUST facilities, faculty and staff aid in your research?

Carrasco Zanini: If we are not attending a KAUST seminar, we are looking for opportunities to contribute to the community, working with the staff of the University's Core Labs to fabricate a new prototype or working with a KAUST professor on a collaborative research project.

The University's Research Park, where we are based, is a very dynamic place where you're always on your toes, waiting to see what new discoveries are produced. Being based here helped our team deliver faster and better results.

The Beacon: Overall, what drives you and the rest of the Intelligent Systems Team to discovery?

Carrasco Zanini: I think it's just in our nature to discover new things—we get our kicks from finding new ways to solve a problem that no one could before, or from finding alternative and hopefully better solutions to problems people have already solved. Obviously, this applies to all researchers in general, but for us, to be able to do this in a field as awesome as robotics—well, it's a really special thing in our work every day.

As our robotic crawler continues to make progress towards a potential market presence, we hope we'll have more opportunities to share the successes of other technologies we're working on as they mature.●

قمنا بالتركيز على ثلاث خصائص رئيسية للروبوت هي: -1العمل بصورة لاسلكية. -2القدرة على الحركة بسلاسة على أنواع مختلفة من الأسطح المنحنية. -3القيام بعمليات التفتيش المختلفة بصورة مستقلة. ثم انتقلت فكرتنا من مجرد حبر على ورق إلى صناعة نموذج اختبار أولي بعد عام ونصف.

كيف تعالج أبحاثكم التحديات الحالية والمستقبلية المتعلقة بصناعة الطاقة في المملكة وتوجهها نحو الاقتصاد المعرفي؟

كاراسكو زانيني: كجزء من قسم سلامة شبكة النفط والغاز في شركة أرامكو، نركز على المشاريع التي ترفع من قدرتنا على مواصلة العمليات التشغيلية المهمة وتجنب تعطلها نتيجة أخطاء أو خلل في خطوط الأنابيب مثلاً. لذلك نولي أهمية بالغة على عملية تفحص الأنابيب والتفتيش عن أماكن التآكل فيها والحد من ذلك سواءً في منشأتنا على الأرض أو تحت الماء.

في الوقت نفسه، نتابع أبحاث وتطوير مجال الروبوتات بحثاً عن فرص ممكنه لتعزيز النمو الاقتصادي للمملكة، وخاصة في قطاع الطاقة، حيث نعتقد أن مصادر الطاقة المتجددة - بما في ذلك الطاقة الشمسية - هي مجالات يمكن لعلم الروبوتات أن يلعب دوراً فاعلاً فيها.

ماهي تطلعات أبحاثكم المستقبلية؟

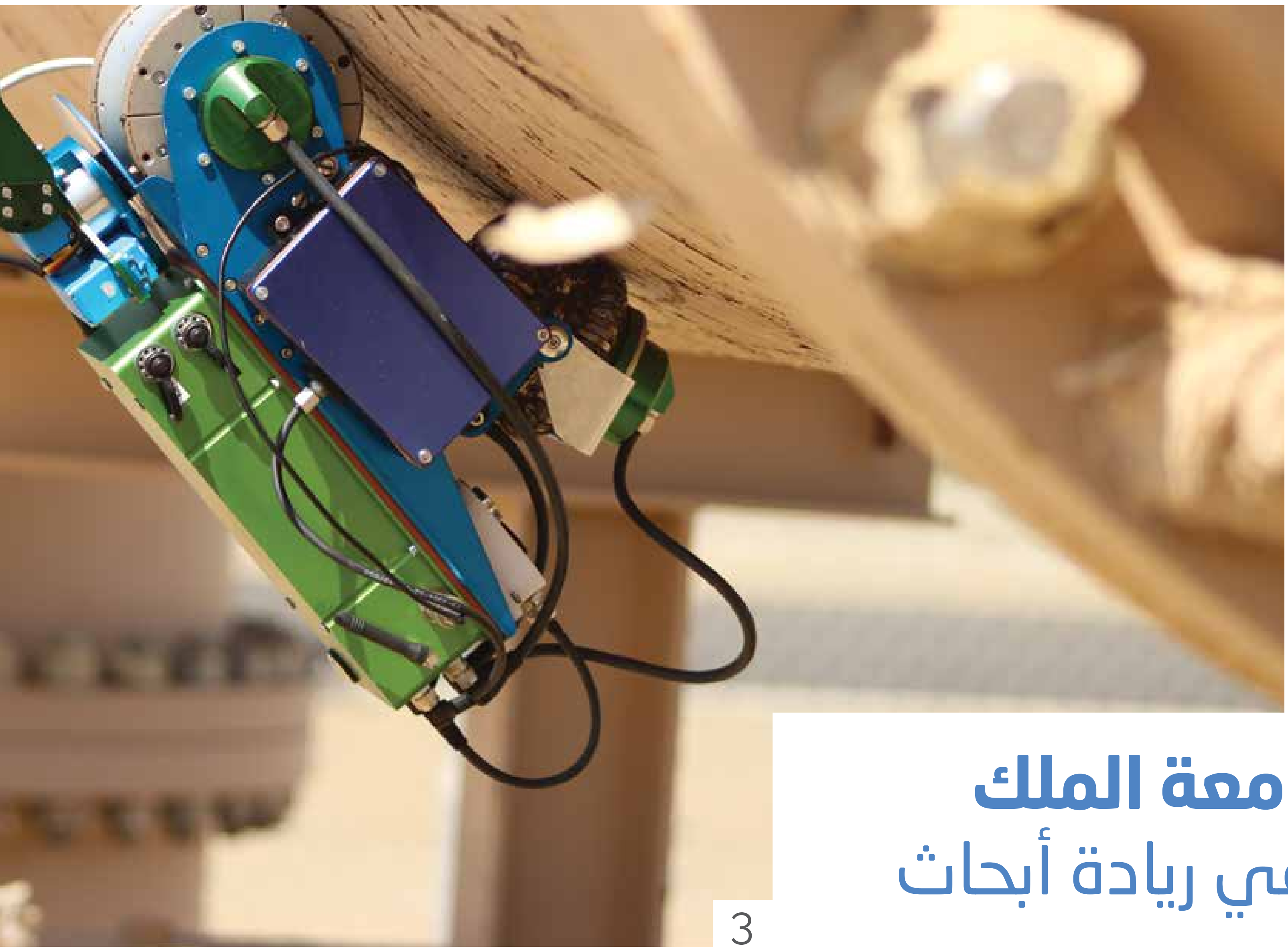
كاراسكو زانيني: نعتقد أننا سنواصل تطوير تقنية وتطبيقات الروبوتات في قطاعات الطاقة والمواد الكيميائية، ومعالجة المشاكل التشغيلية الأكثر تعقيداً والتي قد تستوجب انتقالنا من مجالات الفحص والتفتيش الى مجالات التصليح والصيانة، وتطوير التحكم الذاتي ووضع حلول للتحديات التشغيلية في البيئات ذات الظروف القاسية. اننا نسعى بقوة أن يصبح فريقنا من الفرق الرائدة في مجال تقنية الروبوتات.

كيف ساهمت مرافق جامعة الملك عبدالله وهيئة تدريسها وموظفيها في أبحاثكم؟

كاراسكو زانيني: نحضر دائماً الندوات العلمية المهمة التي تقدمها جامعة الملك عبدالله، ونبحث دائماً عن أي فرصة يمكن من خلالها المساهمة مع مجتمع الجامعة وإثرائه والتعاون مع باحثي وموظفي مختبرات الجامعة الأساسية إما في عملية تصنيع النماذج الأولية أو التعاون مع أساتذة جامعة الملك عبدالله في أي مشروع بحثي.

يقع مختبرنا داخل مجمع الأبحاث في الجامعة، وهو مكان حيوي للغاية يضم كل ما هو جديد من ابتكارات وتقنيات جديدة الأمر الذي ساعد فريقنا في تحقيق نتائج أفضل وفي وقت قياسي.

بقلم كيتلن كلارك وديفيد ميرفي من فريق صحيفة المنارة●



3

خريجو جامعة الملك عبدالله في ريادة أبحاث الروبوتات

قام فريق الأنظمة الذكية التابع لشركة أرامكو السعودية والمكون من خريجي جامعة الملك عبدالله بتصميم وبناء روبوت متحرك خاص داخل الحرم الجامعي في فترة 18 شهراً. ويستطيع هذا الروبوت إجراء علمية فحص وتفتيش الأنابيب والمنشآت الصناعية والتشغيلية لشركة أرامكو لاسلكياً وباستخدام الموجات فوق الصوتية فضلاً عن استشعار الغازات. كما يمتلك تصميم مدمج متطور يمكنه من التحرك على الأسطح المنحنية، ويحمل داخله نظام ذكي قادر على اكتشاف المناطق المعدنية المتآكلة في الصهاريج والحاويات والأنابيب وغيرها من المواقع التي يصعب الوصول إليها.

وتعتبر عملية تصميم وتطوير هذا الروبوت هي الأولى من نوعها التي تتم في هذا الوقت القياسي، حيث تم منح أعضاء الفريق الثمانية ميدالية المجد في الصناعة من الاتحاد الدولي لجمعية المخترعين في عام 2013.

وتعتبر إدارة الأبحاث والتطوير في شركة أرامكو السعودية ان وجود فريق لها من خريجي جامعة الملك عبدالله يعملون معاً في الحرم الجامعي هو فرصة كبيرة لتحفيز قدراتهم وأدائهم، فضلاً عن تعزيز العلاقات بين الأوساط الأكاديمية والصناعية، والاستفادة من التطور السريع في تقنيات الروبوتات.

التقينا مع بابلو كاراسكو زانيني، خريج جامعة الملك عبدالله في الهندسة الميكانيكية ورئيس فريق الأنظمة الذكية، وتحدث عن عملية تطوير هذه التقنية الجديدة ومدى الحماس والتصميم الذي تحلى به فريقه متعدد الجنسيات والتخصصات أثناء ذلك.

ما هو السبب الذي دفعك لدراسة الهندسة الميكانيكية في جامعة الملك عبدالله للعلوم والتقنية؟

كاراسكو زانيني: كنت أدرس هندسة الميكاترونكس (الميكانيكا الإلكترونية) في المكسيك. وكنت قبل تخرجي بفترة قصيرة أبحث عن فرص متميزة لإكمال دراستي العليا لدرجة الماجستير. وقادني بحثي الى برنامج جامعة الملك عبدالله للعلوم والتقنية. حيث بدت لدي أنها فرصة عظيمة للعمل في مرافق عالمية المستوى مع مجموعة دولية من الباحثين. تقدمت بطلب الالتحاق في برنامج المنح الدراسية للجامعة وتم قبولي ثم انضممت الى الدفعة الثانية من طلبة جامعة الملك عبدالله في عام 2010.

حدثنا عن فريق الأنظمة الذكية الذي ترأسه مع بعض التفاصيل عن مركز أرامكو للأبحاث والتطوير في جامعة الملك عبدالله.

كاراسكو زانيني: يضم فريقنا للأنظمة الذكية مجموعة متعددة التخصصات من المهندسين والباحثين من 10 دول مختلفة يعملون داخل مركز الأبحاث والتطوير لشركة أرامكو السعودية، ضمن قسم سلامة شبكة النفط والغاز. ويقع مركزنا داخل الحرم الجامعي لجامعة الملك عبدالله للعلوم والتقنية. ويجري الفريق أبحاثاً رائدة تركز على وضع حلول للتحديات التشغيلية في قطاعات الطاقة والمواد الكيميائية من خلال تطوير التقنيات الروبوتية المتقدمة.

صف لنا الأبحاث التي تقومون بها والاهداف التي تسعون لتحقيقها.

كاراسكو زانيني: أستطيع أن أصف أبحاثنا بالمثيرة، حيث لا يخلو مختبرنا من كل ما هو جديد ومتميز سواءً كانت برمجيات حاسوبية جديدة، أو لوحة كهربائية مطبوعة أو نموذج أولي لروبوت متنقل تحت الاختبار. وهذه طبيعة أبحاث الروبوتات خصوصاً عندما يقود هذه الأبحاث مجموعة رائعة من الباحثين المتحمسين والشغوفين للعلوم.

يركز الفريق بصورة أساسية على حل التحديات الصناعية التي تواجه شركة أرامكو، ولكننا نعمل أيضاً لدعم اقتصاد المملكة من خلال الأبحاث وتطوير التقنيات قدر الإمكان.

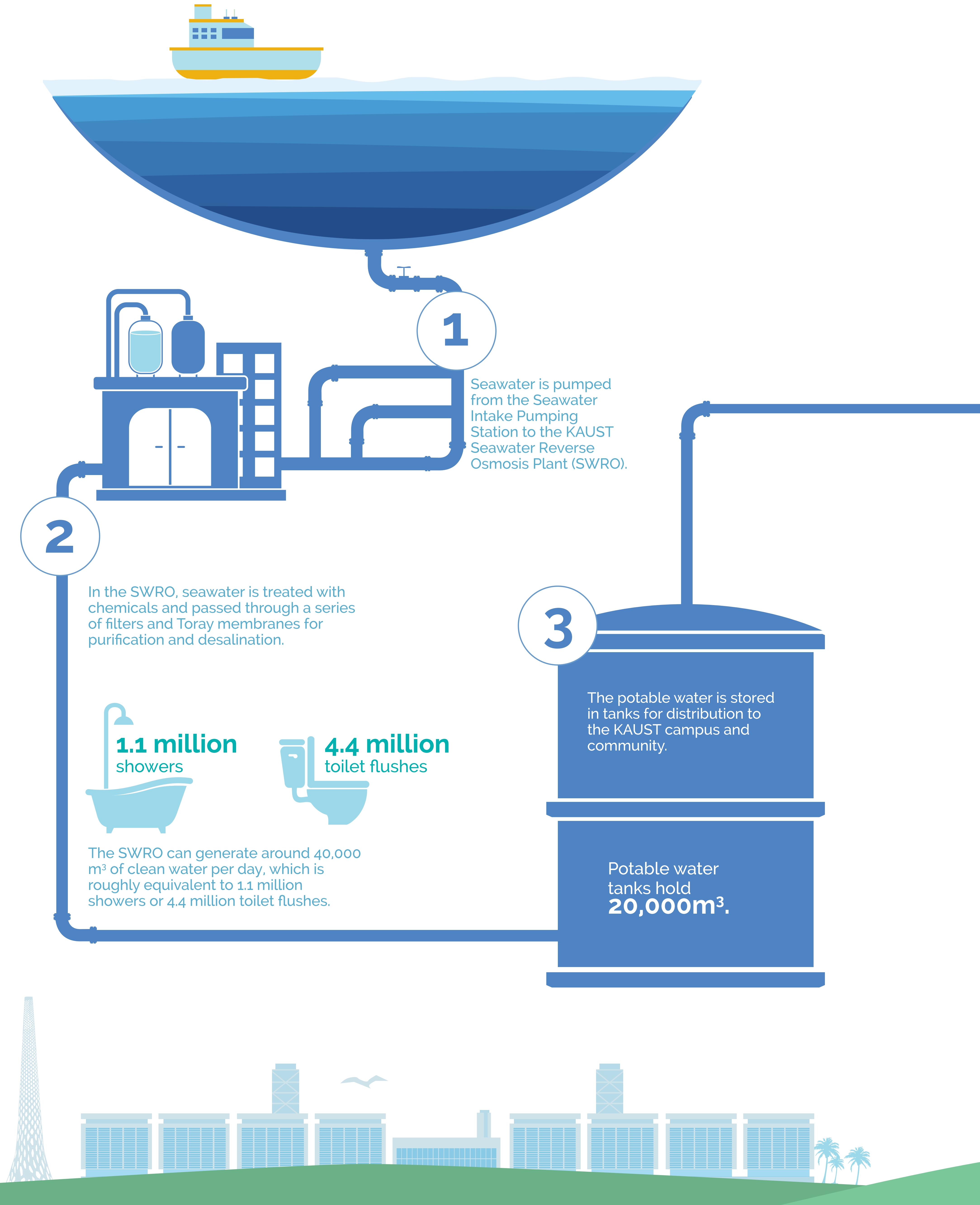
هل لك أن تصف لنا عملية تصميم وتطوير هذا الروبوت المتنقل؟

كاراسكو زانيني: نحن فخورون جداً بالنتائج التي حققناها في تطوير روبوت التفتيش الخاص بشركة أرامكو السعودية، أو ما نحب أن نطلق عليه مسمى SAIR. فقد نشأت فكرة تصميمه في الأساس من فهمنا لاحتياجات العميل وإلمامنا بأحدث التقنيات المتاحة تجارياً سواءً من ناحية فوائدها أو عيوبها.

تعمل تقنية الروبوت على التقليل من النفقات والمخاطر المرتبطة بعملية بناء السقالات لتفتيش المنشآت المرتفعة أو التي يصعب الوصول إليها، ولا توجد في الوقت الحالي أي تقنية مماثلة متاحة تجارياً يمكنها أن تقدم نفس المزايا والقدرة.

The KAUST hydrologic cycle:

How water is harvested, cleaned, used and recycled on campus and in our community



1

Seawater is pumped from the Seawater Intake Pumping Station to the KAUST Seawater Reverse Osmosis Plant (SWRO).

2

In the SWRO, seawater is treated with chemicals and passed through a series of filters and Toray membranes for purification and desalination.

1.1 million
showers

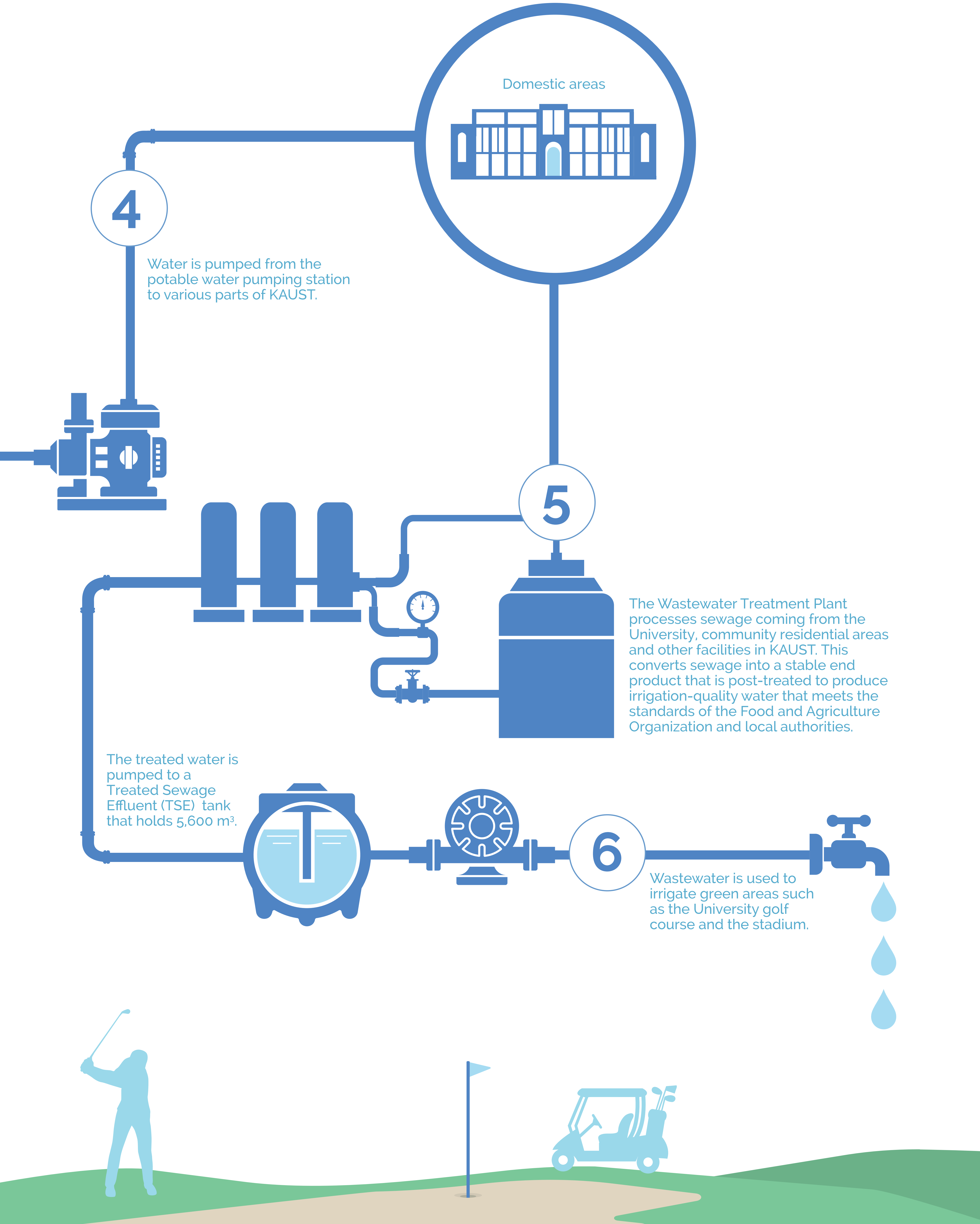
4.4 million
toilet flushes

The SWRO can generate around 40,000 m^3 of clean water per day, which is roughly equivalent to 1.1 million showers or 4.4 million toilet flushes.

3

The potable water is stored in tanks for distribution to the KAUST campus and community.

Potable water tanks hold **20,000m^3.**



Domestic areas

4

Water is pumped from the potable water pumping station to various parts of KAUST.

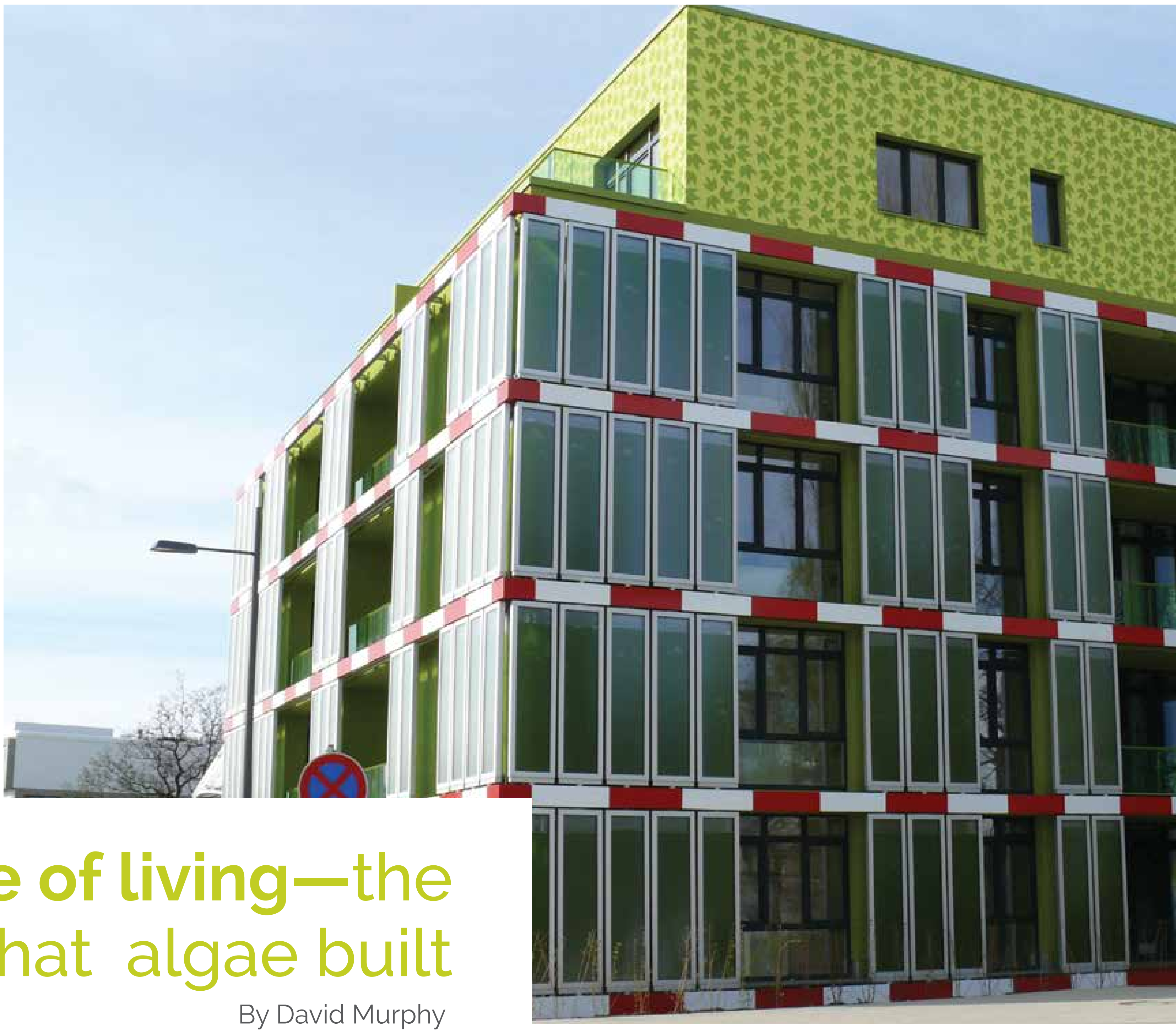
5

The Wastewater Treatment Plant processes sewage coming from the University, community residential areas and other facilities in KAUST. This converts sewage into a stable end product that is post-treated to produce irrigation-quality water that meets the standards of the Food and Agriculture Organization and local authorities.

The treated water is pumped to a Treated Sewage Effluent (TSE) tank that holds 5,600 m^3.

6

Wastewater is used to irrigate green areas such as the University golf course and the stadium.



The future of living—the house that algae built

By David Murphy

Dr. Stefan Hindersin from Germany's Strategic Science Consult GmbH introduced the KAUST community to the world's first "algae house" during an on-campus lecture on January 21. The house, dubbed "BIQ-the Algae House," was built between December 1, 2011 and March 31, 2013 in Hamburg, Germany. The BIQ house is equipped with 200 m^2 of bioreactor facade and is an example of the hoped-for future of urban residential living.

Throughout his career, Hindersin has linked established methods in renewable energy production with approaches to conduct biotechnological microalgae harvesting. His lecture focused on the energy and resource fluxes of the algae facade technology.

A dynamic facade system

The facade system is based on the production of renewable energy through the use of microalgal biomass and thermal heat. Microalgae are cultivated and produced in numerous photobioreactors that are attached as flat panels on the exterior of the building. The photobioreactors produce heat and act as a light shield and a temperature and noise insulator.

The facade may also act as a sink for carbon dioxide (CO2) through the addition of flue gas to the culture medium because algae use CO2 as carbon source to build up biomass. CO2 can be supplied by a decentralized combined heat and power station or a central heating unit. The facade also collects energy by absorbing the light that is not used by the algae to generate heat. As in a solar thermal system, the stored heat can then be used for hot water and heating

Living in the future

Since it began operating in March 2013, the bioreactor facade has been continuously monitored for both its technical performance and its acceptance by the local public and residents. The BIQ house is a promising example of the technology available for the production of sustainable microalgal biomass and microalgae's role as an alternative renewable energy source for the future. With increasing property prices and decreasing land and property options available in large urban areas, the building shows how we may choose to live in the future. ●

1

2

1. The "Algae House" in Hamburg, Germany has 200 m² of bioreactor facade and is an example of a sustainable building we may inhabit in the future. Photo courtesy of Stefan Hindersin.

2. Dr. Stefan Hindersin speaks to the KAUST audience about the sustainable technology of the "Algae House" on January 21.

1

Paper skin sensors for environmental monitoring

Everyday materials found in the kitchen, such as aluminum foil, sticky note paper, sponges and tape, have been used by a team of electrical engineers from KAUST to develop a low-cost sensor that can detect external stimuli, including touch, pressure, temperature, acidity and humidity. Their work was published in the inaugural issue of Advanced Materials Technologies by Wiley-VCH (Germany).

The sensor, which is called Paper Skin, performs as well as other artificial skin applications currently being developed while integrating multiple functions using cost-effective materials.

Promising technological applications

Wearable and flexible electronics show promise for a variety of applications, such as wireless monitoring of patient health and touch-free computer interfaces, but current research in this direction employs expensive and sophisticated materials and processes.

"Our work has the potential to revolutionize the electronics industry and opens the door to commercializing affordable high-performance sensing devices," stated Muhammad Mustafa Hussain, KAUST associate professor of electrical engineering and principal investigator in the University's Integrated Nanotechnology Lab, where the research was conducted.

"Previous efforts in this direction used sophisticated materials or processes," Hussain continued. "Chemically functionalized inkjet printed or vacuum technology-processed papers—albeit cheap—have shown limited functionalities. Here we show a scalable 'garage' fabrication approach using off-the-shelf and inexpensive household elements."

Household items for electronic advances

The team used sticky note paper to detect humidity, sponges and wipes to detect pressure and aluminum foil to detect motion. Coloring a sticky note with an HB pencil allowed the paper to detect acidity levels, and aluminum foil and conductive silver ink were used to detect temperature differences.

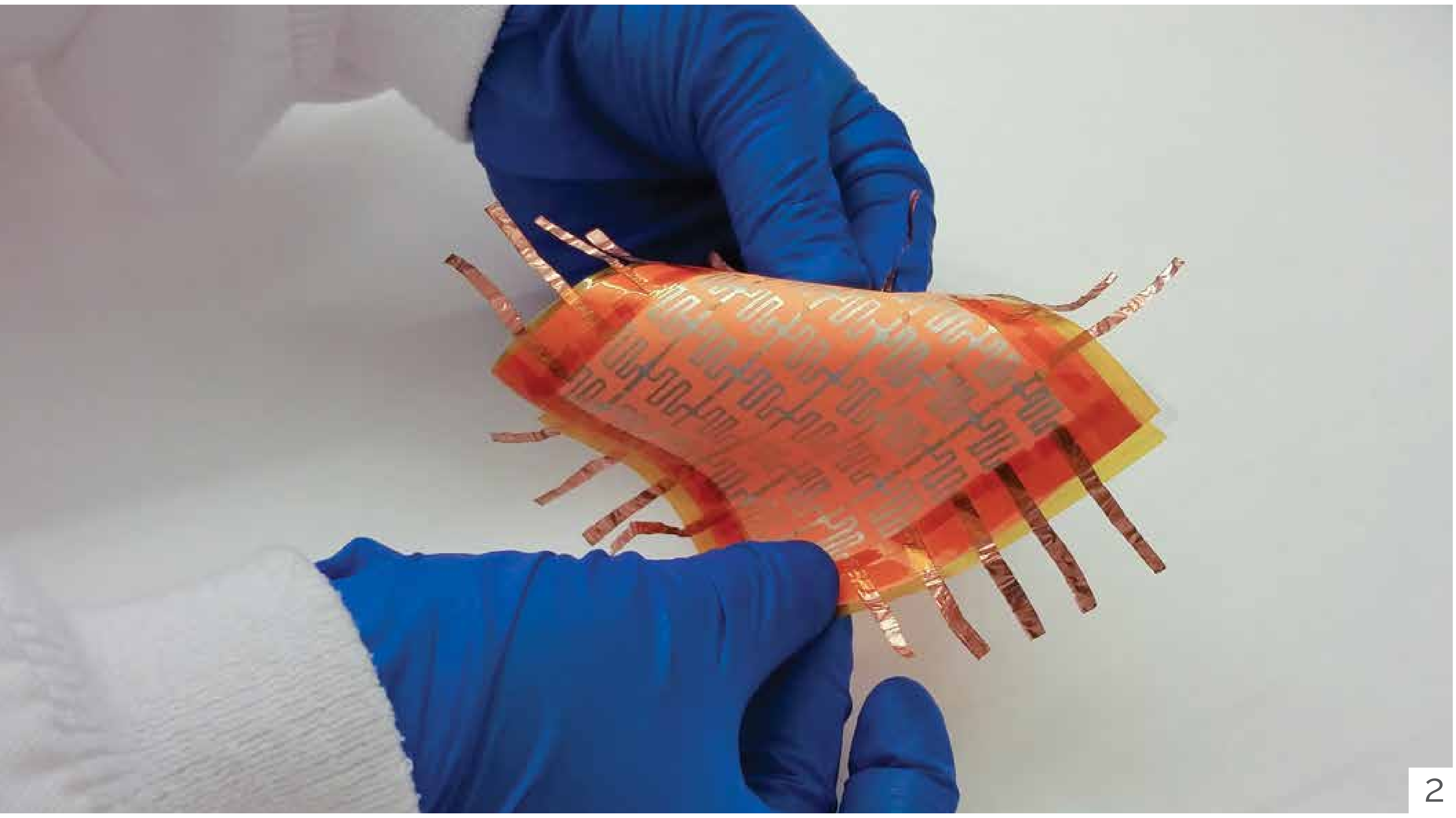
The materials were put together into a simple paper-based platform that was then connected to a device that detected changes in electrical conductivity according to external stimuli.

Increasing levels of humidity, for example, increased the platform's ability to store an electrical charge, or its capacitance. Exposing the sensor to an acidic solution increased its resistance, while exposing it to an alkaline solution decreased it. Voltage changes were detected with temperature changes. Bringing a finger closer to the platform disturbed its electromagnetic field, decreasing its capacitance.

The team leveraged the various properties of the materials they used, including their porosity, adsorption, elasticity and dimensions to develop the low-cost sensory platform. They also demonstrated that a single integrated platform could simultaneously detect multiple stimuli in real time.

The next steps

Several challenges must be overcome before a fully autonomous, flexible and multifunctional sensory platform becomes commercially achievable, explained Hussain. Wireless interaction with the paper skin needs to be developed. Reliability tests also need to be conducted to assess how long the sensor can last and how good its performance is under severe bending conditions.



"The next stage will be to optimize the sensor's integration on this platform for applications in medical monitoring systems. The flexible and conformal sensory platform will enable simultaneous real-time monitoring of body vital signs, such as heart rate, blood pressure, breathing patterns and movement," Hussain said.

"We may also transfer the achieved functionalities of the technology to biologically grown skin and develop mechanisms to connect it to neuronal networks in the human body to assist burn victims, for example. Other applications include robotics, vehicular technology and environmental surveys," he added.

KAUST-NSF Research Conference on Electronic Materials, Devices and Systems for a Sustainable Future

From March 14 to 16, Hussain and colleagues from KAUST and the United States National Science Foundation (NSF) will host the KAUST-NSF Research Conference on Electronic Materials, Devices and Systems for a Sustainable Future on the KAUST campus. There, exciting and groundbreaking work in the electronics field like Hussain's low-cost paper sensor will be highlighted.

The conference will also provide the opportunity for the KAUST scholarly community to exhibit research and innovations through a poster presentation session.

The conference is made possible with financial support from the KAUST Office of Sponsored Research. It is co-sponsored by the National Science Foundation, United States of America, the KAUST Industry Collaboration Program (KICP) and the Computer, Electrical and Mathematical Science and Engineering (CEMSE) Division.●

---

1. KAUST Associate Professor of Electrical Engineering Muhammad Mustafa Hussain. File photo.

2. Associate Professor Muhammad Mustafa Hussain and team's low-cost Paper Skin sensor can detect external stimuli, including pressure, touch, temperature, acidity and humidity, and was constructed from everyday materials found around the home.

Reality check for **Red Sea wave predictions**

Improved modelling of Red Sea wind and waves by KAUST scientists will enhance simulations of ocean-surface conditions in the Red Sea.

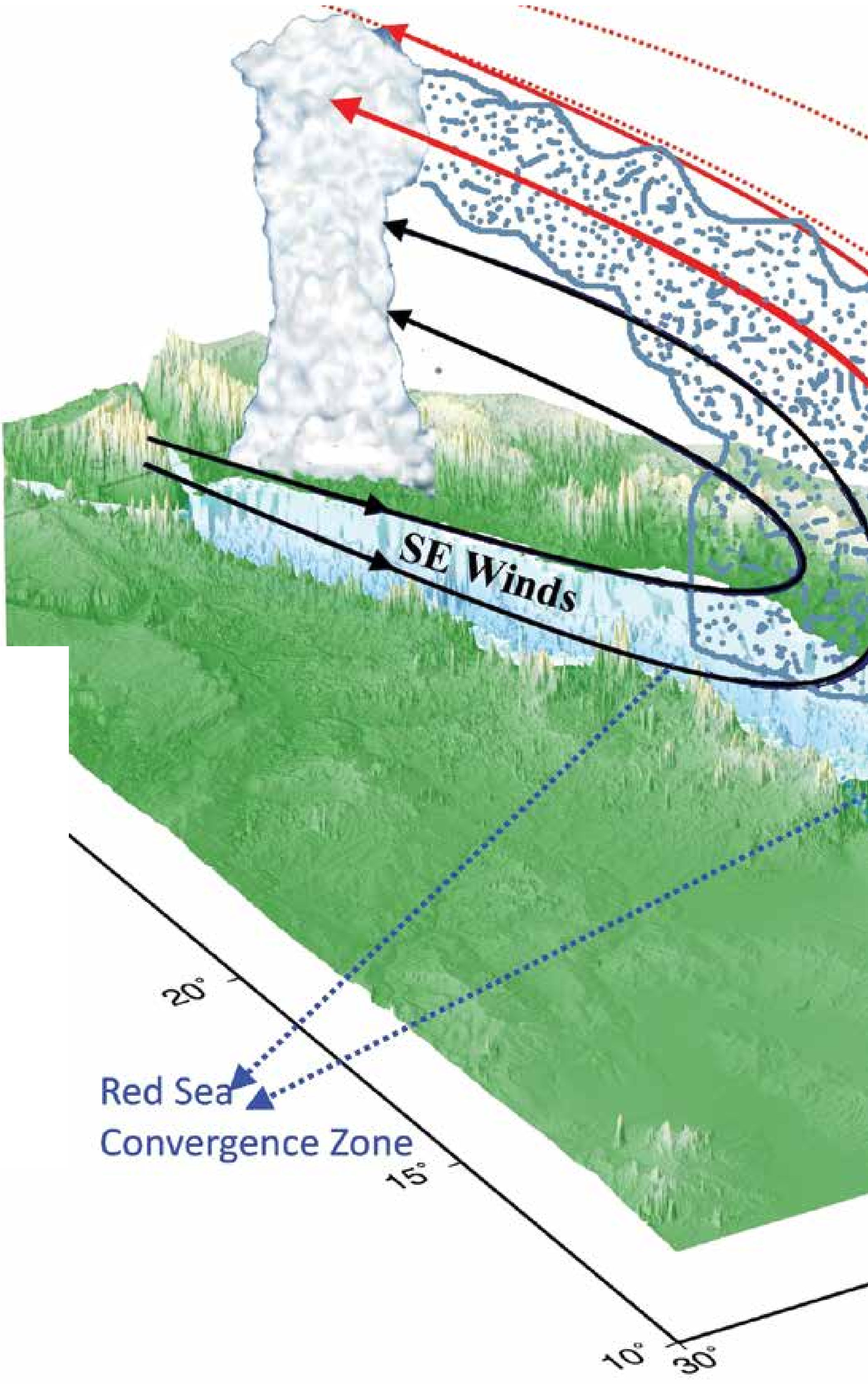
Mathematical wind-wave models are used to illustrate past and future ocean surface conditions. They are important for coastal oceanographic studies, coastal management activities, ocean engineering and maritime activities. While satisfactorily accurate for open oceans, these models have been inadequate for conditions on enclosed seas.

Predicting conditions in the Red Sea is particularly challenging because of the Red Sea's long and narrow shape. "This makes the local conditions extremely sensitive to even minor changes in the direction of the driving wind fields," explained Ibrahim Hoteit, KAUST associate professor of earth science and engineering.

The Red Sea basin is bordered by mountain ranges on both sides, transforming it into a wind tunnel. In the winter months, winds blow in a south-easterly direction from the Mediterranean and a north-westerly direction from the Gulf of Aden. These two opposing wind systems meet in the so-called "Red Sea convergence zone," producing complicated wave patterns that depend on small details in the driving winds.

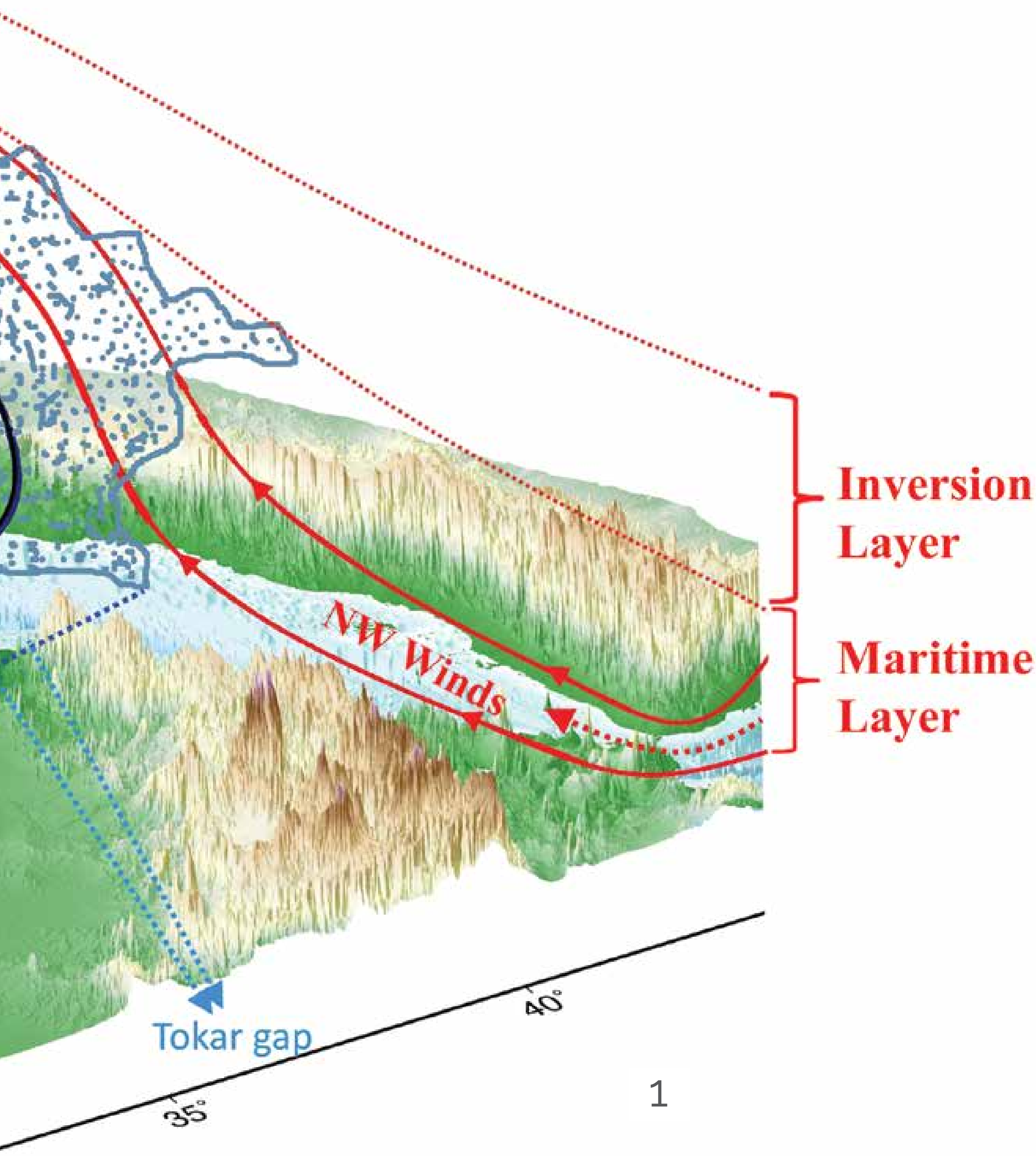
A team of scientists from KAUST and the Institute of Marine Sciences in Italy compared predictions of WAVEWATCH III, a widely used state-of-the-art wave model, with actual data from satellites and meteo-oceanographic buoys in the Red Sea.

Their results suggested that current inputs to the model do not properly represent the evolution of wind-wave patterns, especially in the convergence zone. Even with correct or underestimated wind conditions, the model tended to overestimate the wave conditions, particularly in the convergence zone. By modifying details in the model's equations, the team managed to improve the wave-model simulation under opposing wind and wave conditions.



"Precise knowledge of sea-state information and its climatology would be highly beneficial to marine activities ranging from conventional fishing to transportation of goods and crude oil," said KAUST Ph.D. student Sabique Langodan. "This study developed an accurate representation of wave fields in the Red Sea...[and] provided a unique opportunity to study the evolution of two wave systems of similar amplitude and frequency propagating in opposite directions." The study can be considered an important contribution to future developments of wave models, he explained.

The team is currently studying how wind and wave patterns in the Red Sea have varied over time. They are also characterizing wind and wave energy resources to identify the Red Sea's potential as a renewable energy source.●

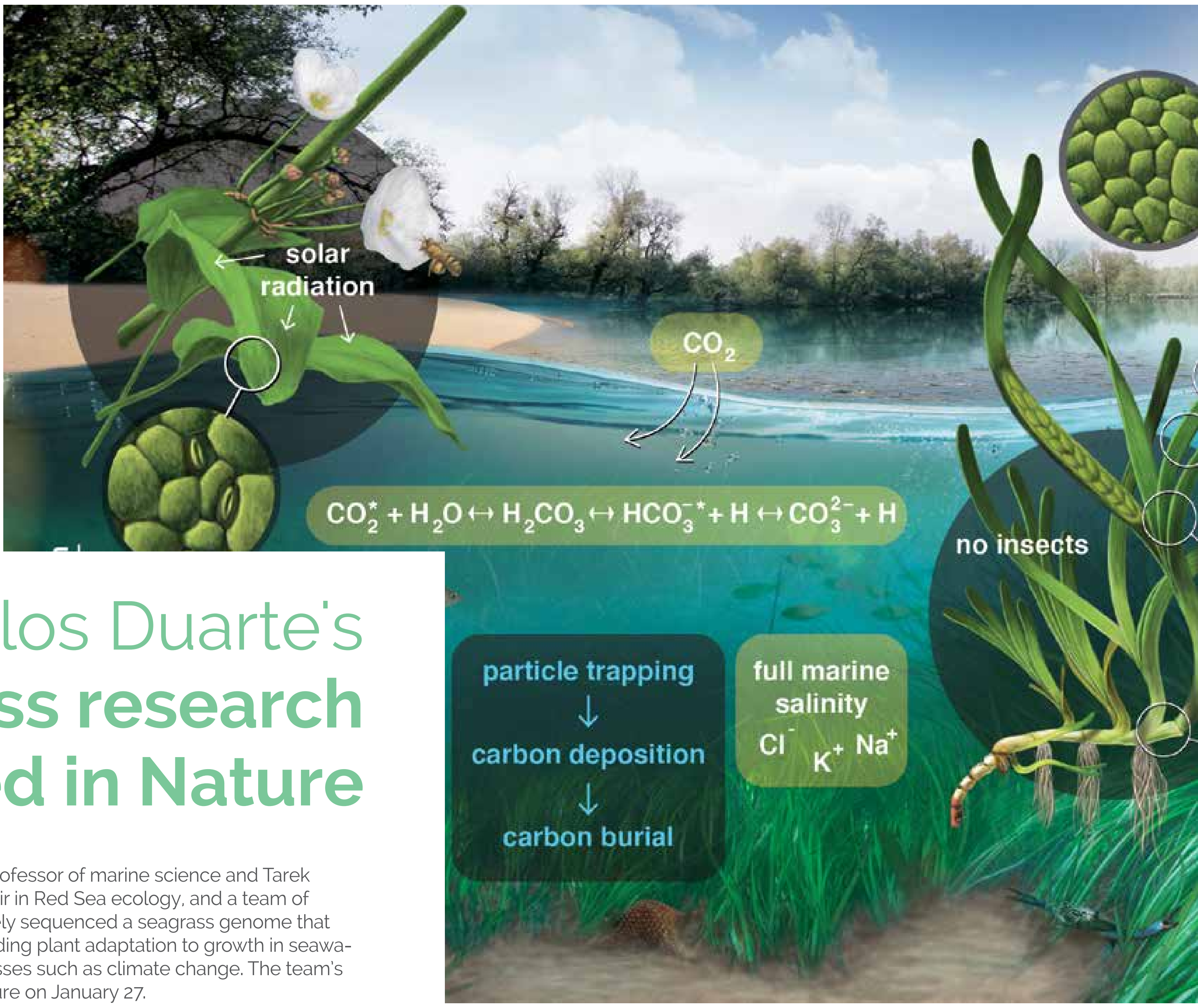


1

2

1. Warm northwesterly winds meet cold southeasterly winds in the Red Sea's convergence zone. The warm winds flow on top of the cold winds, trapping them and forcing them to reverse at a higher altitude. This creates a cloudy zone, unusual for the sunny Red Sea. Reproduced with permission from Journal of Geophysical Research: Oceans.

2. Ibrahim Hoteit, KAUST associate professor of earth science and engineering. File photo.



Carlos Duarte's **eelgrass research published in Nature**

Carlos M. Duarte, KAUST professor of marine science and Tarek Ahmed Juffali research chair in Red Sea ecology, and a team of researchers have completely sequenced a seagrass genome that could be vital to understanding plant adaptation to growth in seawater and vulnerability to stresses such as climate change. The team's work was published in Nature on January 27.

Seagrasses are a small set of about 60 species of flowering plants that, early in the evolution of higher plants, adapted to life in the ocean. They were once a terrestrial species that evolved to grow in salt water and now form some of the most productive and ecologically important ecosystems in the ocean.

Zostera marina, the seagrass under study, is commonly known as "eelgrass." It lost a number of genes on its way into the ocean as the interaction with insects and the role of compounds emitted to the atmosphere in signaling are lost in the sea. Z. marina in turn evolved a number of mechanisms to resist salt, which may shed light on selective breeding techniques that could make food crops more salt-tolerant.

"Seagrasses are a neglected group of higher plants that represent about one in every 5,000 species. They are of huge significance as they are the only marine plants that were able to fully colonize the sea," said Duarte.

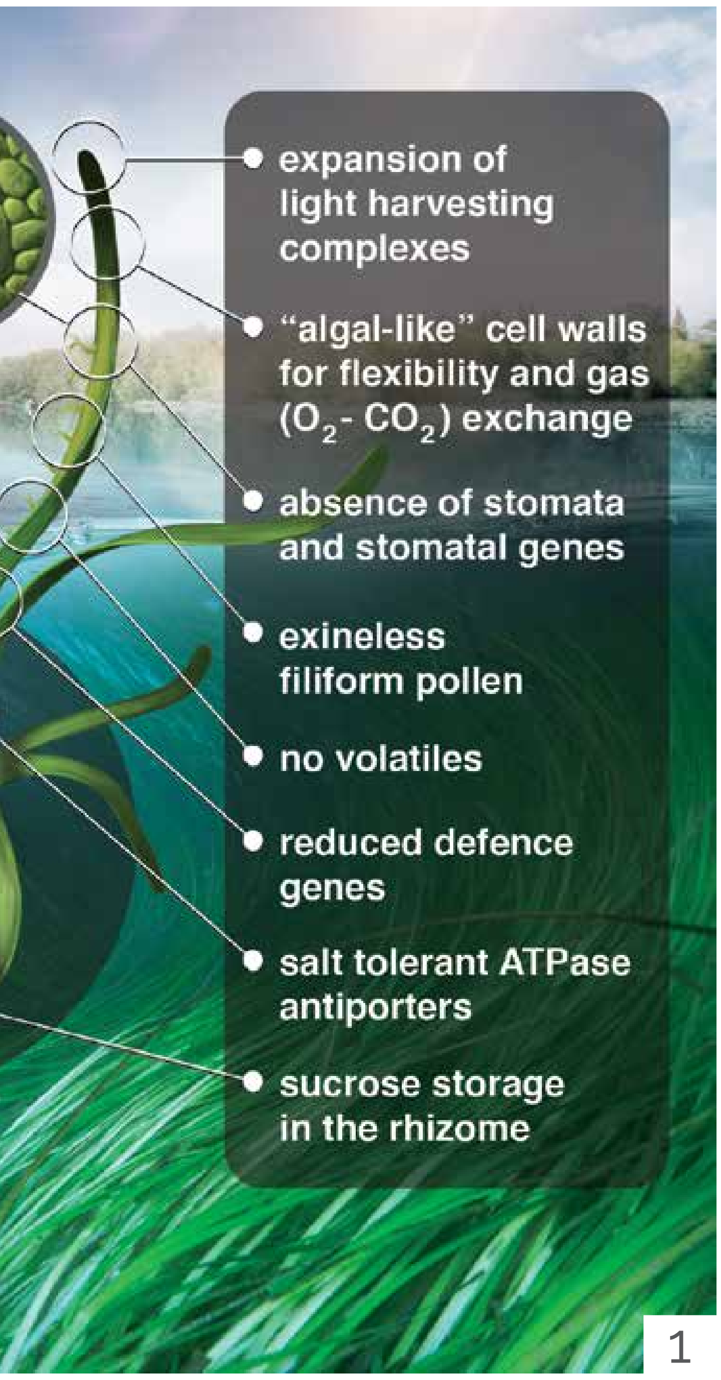
Understanding the Z. marina genome can help elucidate vulnerabilities to global stressors like climate change that are leading to a rapid loss of seagrass ecosystems. Studies of the adaptive capacity of seagrasses might also help drive more effective conservation efforts to these threatened ecosystems.

"This has been a long process taking more than seven years. A large number of people were required to disentangle the evolutionary code contained in the genome of this marine plant," Duarte noted.

The Nature letter entitled "The genome of the seagrass Zostera marina reveals angiosperm adaptation to the sea" is the result of a research effort led by University of Groningen Professor of Marine Biology Jeanine Olsen.

The international collaboration involved over 35 laboratories around the world, including the Groningen Institute of Evolutionary Life Sciences (GELIFES), University of Groningen; the Red Sea Research Center, KAUST; the Department of Plant Biotechnology and Bioinformatics, Ghent University; and the Dipartimento di Scienze Agrarie e Ambientali, University of Udine.●

2


expansion of light harvesting complexes
"algal-like" cell walls for flexibility and gas (O_2 - CO_2) exchange
absence of stomata and stomatal genes
exineless filiform pollen
no volatiles
reduced defence genes
salt tolerant ATPase antiporters
sucrose storage in the rhizome

1

1. A figure published as part of the Nature letter. By Ivan Gromicho

2. Professor Carlos M. Duarte, the Tarek Ahmed Juffali research chair in Red Sea ecology.

مجلة نيتشر تنشر بحثاً
للبروفيسور كارلوس دوارتي

نشرت مجلة نيتشر (Nature) في عددها الصادر يوم الأربعاء، 27 يناير 2016، دراسة بحثية مشتركة وضخمة عن التسلسل الجينومي للأعشاب البحرية شارك بها أستاذ علوم البحار، البروفيسور كارلوس دوارتي وفريقه العلمي في جامعة الملك عبدالله للعلوم والتقنية مع جامعات عالمية أخرى. وتعد هذه الدراسة مهمة جداً في شرح كيفية نمو النباتات وتكيفها في مياه البحر وتحت الظروف البيئية القاسية الأخرى كالتغييرات المناخية.

الأعشاب البحرية هي مجموعة صغيرة من حوالي 60 نوعاً من النباتات الزهرية التي تكيفت على الحياة في المحيطات في وقت مبكر، ثم تطورت لتنمو في المياه المالحة بصورة كاملة. وتعتبر الأعشاب البحرية من أكثر النظم البيئية المهمة والمنتجة في المحيطات.

قام فريق البروفيسور دوراتي بدارسة نوع من الأعشاب البحرية يطلق عليها الحزامية البحرية (Zostera marina)، وهي فصيلة نباتية فقدت عدداً من جيناتها أثناء عملية تكيفها للنمو في المحيطات وتفاعلاتها مع الكائنات الحية والحشرات والمركبات المنبعثة في الغلاف الجوي. إلا أنها طورت عدداً من الآليات لمقاومة الملوحة، والتي يمكن دراستها وتطبيقها على تقنيات التربية الانتقائية من أجل زيادة تحمل المحاصيل الغذائية للملوحة. يقول دوراتي: "الأعشاب البحرية هي مجموعة مهملة من النباتات العليا، حيث أن لها أهمية كبيرة جداً خصوصاً كونها النباتات البحرية الوحيدة التي يمكنها الاستيطان الكامل في البحار."

ساعدت دراسة جينوم الحزامية البحرية (Zostera marina) والمشهورة أيضاً بمسمى إيلجاجراس (Eelgrass)، ساعدت العلماء والباحثين في تحديد نقاط ضعف النباتات في مواجهة الظروف البيئية القاسية والمجهدة مثل التغيرات المناخية، والتي تؤدي إلى فقدان مضطرد لبيئات الأعشاب البحرية. كما أن دراسة القدرة التكيفية لهذه الأعشاب قد يدفع جهود المحافظة على فعالية هذه النظم البيئية المهددة. يقول دوراتي: "استغرقت هذه الدراسة فترة طويلة تجاوزت سبع سنوات حيث تطلب الأمر عدداً كبيراً من الناس للقيام بعملية فصل الرمز التطوري وإكمال التسلسل الجينومي لهذه الأعشاب البحرية".

وقادت هذه الدراسة أستاذة علوم الأحياء البحرية جانين أولسن من جامعة خرونينغن بمشاركة أكثر من 35 مختبراً من جميع أنحاء العالم بما في ذلك معهد خرونينغن لعلوم الحياة التطورية، ومركز أبحاث البحر الأحمر في جامعة الملك عبد الله للعلوم والتقنية، وقسم التقنية الحيوية النباتية والمعلوماتية الحيوية في جامعة غنت، وقسم العلوم الزراعية والبيئية في جامعة أوديني.

نبذة عن البروفيسور كارلوس دوراتي

البروفيسور كارلوس دوراتي، أستاذ علوم البحار واستاذ كرسي طارق أحمد الجفالي لعلوم أحياء البحر الأحمر في قسم العلوم والهندسة البيولوجية والبيئية في جامعة الملك عبدالله للعلوم والتقنية، وتتركز أبحاثه على دراسة آثار تغير المناخ العالمي على النظم البيئية "الإيكولوجية" البحرية، مع تناول جميع مكوناتها-التي تمتد من الكائنات الحية الدقيقة "الميكروبات" إلى أن تصل إلى الحيوانات الضخمة أو العملاقة.

حصل البروفيسور دوراتي على ميدالية فلاديمير ايفانوفيتش فردانسكي لعام 2016 من الاتحاد الأوروبي لعلوم الأرض (EGU) تكريماً لإسهاماته البارزة في مجال العلوم البيولوجية.

نبذة عن جامعة الملك عبدالله للعلوم والتقنية

جامعة الملك عبدالله للعلوم والتقنية هي جامعة أبحاث للدراسات العليا أنشئت في عام 2009 على شواطىء البحر الأحمر وتلعب دوراً مهماً في النهوض بالعلوم والتقنية من خلال التعليم والابتكار والأبحاث التعاونية متعددة التخصصات ذات الأهمية الإقليمية والعالمية في مجالات الماء، والغذاء والطاقة والبيئة والتي يقوم بها طلبة وباحثون وأعضاء هيئة تدريس بارزون. ● www.kaust.edu.sa

Relax! High-resolution imaging **reveals atomic structure** of an important plant stress factor

By Meres J. Weche

All organisms use protein-based communication networks to perceive and respond to changes in environmental conditions. These networks are also used in plants to sense and react to stress conditions, such as those resulting from drought or attack from pathogens. Increased demand, altered weather patterns and emergence of novel pathogens steadily augment stress on food crops. Increasing plant resilience is therefore key to assuring food security. If we understand in detail the interactions formed between proteins that communicate plant stress, we might be able to engineer more stress-tolerant plants. That is why a recent breakthrough by KAUST Associate Professor of Bioscience Stefan Arold's group is of notable importance.

Making use of the powerful X-rays generated by the SOLEIL synchrotron in Paris, France, the KAUST group represented by postdoctoral fellow Umar Farook Shahul Hameed became the first to determine the atomic 3-D structure of a key protein for mediating plant stress signaling.

Arold explained: "My group is working on structural biology. In particular, we use X-ray crystallography, which is a method that allows the visualization of the 3-D atomic structure of proteins. The unique 3-D structure, which is made of tens or hundreds of thousands of atoms, enables the function of each protein, so unraveling the 3-D structure of proteins allows us to understand their function."

Mapping the way towards transgenic plants

The work was carried out at the beamline PROXIMA II of the SOLEIL synchrotron, which is equipped with advanced microfocus optics that focalize the formidable X-ray beam on a surface as small as five micrometers. This setup was used to irradiate a tiny crystal formed by the plant enzyme. It took Hameed more than six months to optimize this fragile crystal of a size of less than one twentieth of a millimeter. The interactions of the X-rays with electrons making up each atom of each protein in the crystal result in a diffraction pattern. From this pattern, which consists of hundreds of thousands of data points, the 3-D protein structure can be obtained to atomic detail.

In order to capture the weak diffraction pattern from the tiny crystal, the team needed to use the most advanced detector for X-ray diffraction experiments, the EIGER 9M, which had just been installed at the PROXIMA II beamline. To obtain a full data set, the protein crystal is rotated by 0.1 degree, and for each rotation, a picture is recorded until a complete 180-degree view of the crystal is achieved. The EIGER 9M detector has the ability to capture a picture every 0.025 seconds, sensing every photon. That means it can record the 1,800 picture frames in 45 seconds.

"The EIGER 9M is not only extremely sensitive, but also extremely fast. In 45 seconds, Umar was able to obtain very beautiful data sets that allowed us to see every detail of the molecule," said Arold. "We not only got the molecule but also a cofactor and the ligand, the protein that binds and activates it."

Arold acknowledges that structure determination would not have been possible without the sensitivity and speed of the top-notch instrument. "We are very thankful to Drs. William Shepard, Martin Savko and Gavin Fox from the PROXIMA II beamline for their support and for allowing us to beta-test this fantastic setup. I'm glad we became the first to determine a novel structure with it," he said.

Even though the protein is a tiny component of the plant, it is critical for its function and survival.

"Understanding the precise structure of the protein is significant because it plays a crucial role in the plants' protective functions from stress tolerance to invading microorganisms," Hameed noted. "When more information becomes available based on the structure, it might inspire mutants that can produce more resistant plants."

Therefore, the vital step of characterizing the enzyme's 3-D structure opens the door to understanding what role it plays in plant stress tolerance, and it will guide efforts to produce transgenic plants that might grow in desert conditions or in high salt concentration areas.

1

Delving deeper into the protein's past

Although the enzyme is responsible for activating the cellular response to environmental stress in plants, similar proteins are also found in animals, including humans.

"Now that we've got the structure, it's surprising how little it has changed over the period of 1 billion years since humans and plants diverged," Arold added. "It's such an important factor that nature hasn't changed its overall structure ever since it arose in the unicellular ancestor of plants and animals."

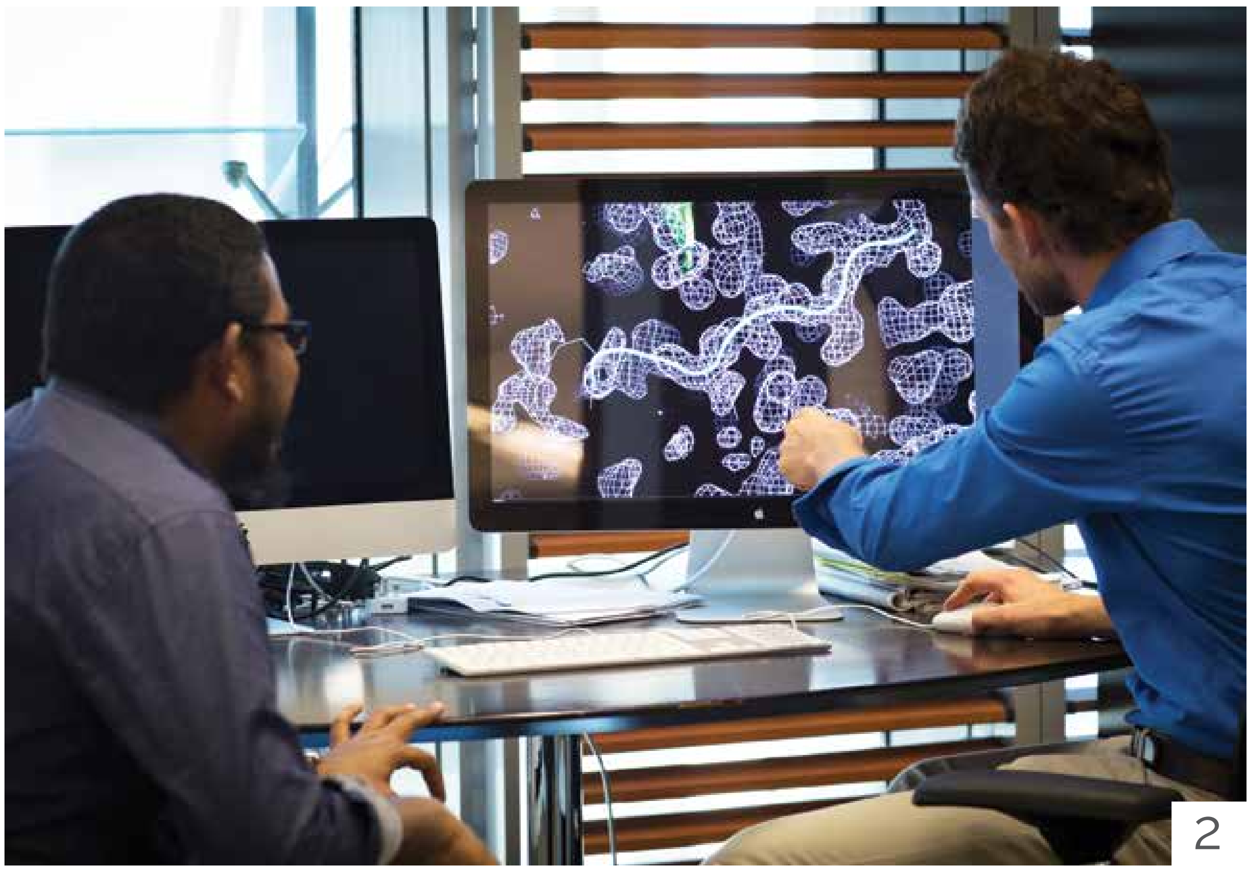
Although the protein, in its shape and composition, is highly conserved, it is used in many different contexts in different species. Understanding how similar proteins can selectively control different functions is an important challenge.

The enzyme that Arold and Hameed studied is derived from the plant Arabidopsis thaliana, a model organism used in plant biology. Yet there are in fact more than 20 similar proteins present in Arabidopsis. Now that the 3-D structure has been obtained for one of them, this facilitates the analysis of the 19 others. For the Arold group, follow-up work also includes studying the structural mechanisms by which the plant enzyme interacts with DNA and particular ions. These interactions have a central effect in modulating stress responses.

A collaborative effort: from atom to organism

This project to characterize the 3-D structure of the protein identified as key for plant stress and immunity is part of a collaborative effort with Professor of Plant Science Heribert Hirt's plant science group at KAUST. Hirt's group focuses on the fundamental biology of plants at the molecular and physiological level, their interactions with the physical (heat, salt and drought) and chemical environment, as well as their connections to other life forms.

"This type of interdisciplinary collaboration at KAUST is very powerful because we can link the information at the atomic level with the entire organism. Together the results should produce a beautiful and insightful story," said Arold.●


2

1. Stefan Arold and Umar Farook Shahul Hameed (right) outside the University's Ibn Al Haytham building in December 2015.

2. Umar Farook Shahul Hameed (left) and Stefan Arold discuss the structure of the plant protein they studied.

Alumni highlight work and achievements

By Diane Burgoyne

Seven KAUST alumni returned to campus on January 14 to speak about their careers during the fifth Alumni Lecture Series. After graduation, the group went to a variety of positions in the United States, Mexico, East Africa and Saudi Arabia. In total, the KAUST alumni community is represented by over 1,000 alumni in 53 countries.

Speaker **Casey Zakroff,** a KAUST master's degree alumnus in marine science, is currently a doctoral student and National Science Fellow at MIT/Woods Hole Oceanographic Institution in the U.S. He studies the effects of ocean acidification on squid. In his presentation he spoke about the importance of communicating science to the general public. Through this, he said, the public takes action and aids in the development of policy for global issues like climate change. In his work, he focuses on the translation of complex scientific data and concepts into concise, understandable and engaging information.

Gary and Kathryn Bolt, KAUST alumni in environmental science and engineering, are located in Rwanda working for the Jibu Company installing and maintaining water treatment systems. The company's goal is to provide a sustainable approach to water aid using a combination of for-profit and non-profit business models. Each water-selling store creates between four and eight jobs making and bottling water. The company also provides small loans, equipment and sustainable treatment systems run by solar power. The Bolts travel from franchise to franchise, giving advice and training and providing maintenance to the water systems.

Aun Mela graduated from KAUST in 2011 with a master's degree in electrical engineering. He is a clean energy analyst in the Renewable Energy Department of Saudi Aramco, and is also working on a second master's degree in electrical energy from the Georgia Institute of Technology. He gave a presentation outlining the domestic, regional and global outlook on renewable energy resources and their increasing cost-competitiveness. He also discussed Saudi Aramco's past and present work on renewables.

Perdana Prihartato received his master's degree and his Ph.D. from KAUST in marine science in 2010 and 2014, respectively. He now works as an environmental scientist at Saudi Aramco, where he helps mitigate the company's impact on the marine environment. He noted how Saudi Aramco is committed to environmental protection through initiatives such as its carbon management program, which uses carbon sequestration, and its mangrove Eco-Parks and offshore islands, which are part of Aramco's biodiversity program. Aramco also initiated the first industrial "blue carbon" program that calculates the carbon sequestration in the marine environment (by mangroves, seagrass and salt flats, for example).

Fernando Figueroa Ortega is a 2010 master's degree recipient in environmental science and engineering. After graduation, he joined the industrial ecology master's program of the European Commission, studying in Austria and the Netherlands and working for Shell. He now works in Mexico, where he coordinates industry self-regulatory programs of the Guanajuato Environmental Agency. In his presentation, Figueroa Ortega spoke about tackling major challenges through interdisciplinary mechanisms—using methods from several disciplines to solve a problem. He presented his career experience as a case study and discussed how knowledge gained during graduate studies can be adapted.

Dhafer Alsalah, a 2014 KAUST master's degree recipient in environmental science and engineering, now works as an environmental researcher at King Abdulaziz City for Science and Technology in Riyadh. He spoke about the consequences of antibiotic overuse on ground water, noting a study of the wells used by pilgrims during the Hajj and the effect of antibiotic use in a nearby poultry farm on the downstream groundwater.●

1. Alumni speakers (L to R) Dhafer Alsalah, Aun Mela, Kathryn Bolt, Perdana Prihartato, Gary Bolt and Casey Zakroff pose with Dean of Graduate Affairs Brian Moran, KAUST President Jean-Lou Chameau and Graduate Affairs Alumni Coordinator Teemu Hentunen.

2. Fernando Figueroa Ortega answers a question during the fifth Alumni Lecture Series about adapting what is learned in graduate school to future jobs.

3. Perdano Prihartato speaks about industrial blue carbon mitigation.

4. Aun Mela discusses renewables in the age of sustainability.

1

2

3

4

My University

Francesca Serra

Francesca Serra hails from Trieste, an Italian city located on the border with Slovenia. After receiving her Ph.D. in applied chemistry from the University of Ghent, she spent nine years working for the European Commission developing protocols to implement anti-fraud EU laws. While concentrating on fraud issues concerning salmon, wine, butter and tartaric acid, she began to move into a scientific communications role, working on videos and promotional materials.

At KAUST, Serra is a communications coordinator in the University's Computer, Electrical and Mathematical Science and Engineering (CEMSE) Division.

"Although I was offered positions in Afghanistan and East Timor with the European Delegation before joining KAUST, I wanted to come here because I had studied Arabic for a few years, and was intrigued by the thought of living in Saudi Arabia," she said.

Serra loves the multicultural and unique environment of KAUST. "The University is more than I expected in every possible aspect," she said. "At first I thought such a multicultural work environment might be tricky, but it is actually fantastic, and the campus is a mesmerizing experience for the eyes. I also enjoy exploring outside of KAUST—in Al-Balad, I go to discover new paths between the old buildings and listen to the buildings' stories."

"I am sure KAUST will have a bright future," she continued, "and will be a beacon for the Kingdom and the entire world. I'm proud that some beams of that light have my colors."●

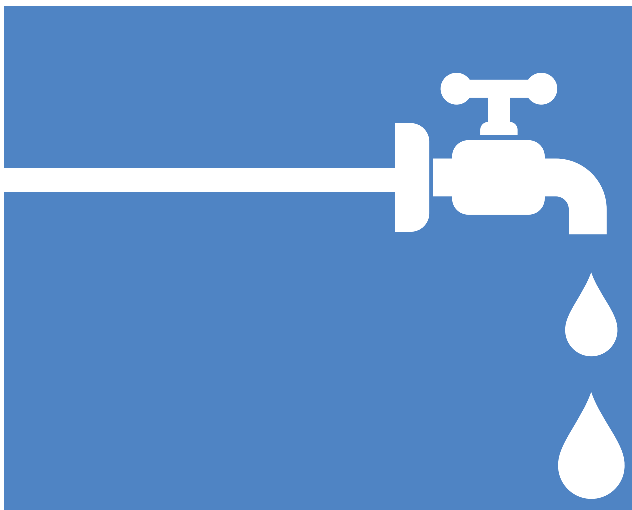
Where do you read The Beacon?

This month's submission comes from Gabriel Büchel, a postdoctoral fellow in the Biological & Organometallic Catalysis Laboratories, part of the KAUST Catalysis Center (KCC).

For almost all of 2015, Büchel lived in New York, where he was working in collaboration with Memorial Sloan Kettering Cancer Center. There he developed a new tool for intraoperative imaging using chemiluminescence.

"My photo was taken in Midtown, and shows the Empire State Building right behind me," Büchel said. "You can also see the Chrysler Building in the background on the left side of the picture."

Büchel enjoyed his time in the "Big Apple" because "it's a true metropolis with lots of different cultures living there and many excitements to be found," he explained. "I especially enjoyed Central Park changing throughout the seasons and the different views over Manhattan from various high-rise buildings."●



Before you turn on the faucet

Stop and think about what you can do to lessen your footprint. Here are some statistics that will make you think every time you turn on the faucet.

How much water do you use?

- Most homes use 33 gallons or 150 liters of water per day.
- It takes 2-7 gallons of water to flush a toilet.
- Brushing your teeth requires around 2 gallons of water.
- It takes 15-25 gallons for the average five-minute shower.
- It takes 9-12 gallons on average to run an automatic dishwasher.
- It takes 9-20 gallons of water to hand wash dishes.
- It takes approximately 1 gallon of water to process a quarter pound of hamburger.
- It takes 39,090 gallons to manufacture a new car, including new tires.
- A dairy cow drinks 4 gallons of water to produce 1 gallon of milk.
- It takes 6 gallons of water to grow and produce french fries.
- It takes about 37 gallons of water to grow coffee beans and process them to make 1 cup of coffee.
- The manufacturing of a smartphone takes 240 gallons of water.
- More than 1,300 gallons of water is required to produce a 12 oz. steak.
- About 6,800 gallons of water is required to grow a day's food for a family of four.
- Of all the water that enters each household, about 95% of it ends up down the drain.
- Every time you throw your clothes in the washing machine, you use about 50 gallons of water.
- If you shorten your showers by a single minute, you can save approximately 700 gallons of water per month.●

ثول
حفل تدشين مشاريع

خالد الفيصل يستنهض همم الوزراء لتنفيذ نموذج ثول في جميع محافظات مكة

KAUST hosts **Prince Khaled Al-Faisal**

Prince Khaled Al-Faisal, emir of Makkah and advisor to the Custodian of the Two Holy Mosques, launched a number of educational, social and health projects in Thuwal on February 9.

The projects included seven schools for boys and girls, drainage projects, a medical complex and five mosques, including Omar Bin Khattab Mosque, which has a capacity for 1,500 worshipers. Prince Khaled also inaugurated the Thuwal Cultural Park, which consists of playgrounds for children, a heritage souk, restaurants, wedding halls and green spaces, the Saudi Press Agency reported.

KAUST organized an celebratory event on the same day to commemorate the emir's visit to Thuwal.

Several ministers accompanied Prince Khaled during his inspection tour of Thuwal. They included Minister of Petroleum and Mineral Resources Ali Al-Naimi, who is chairman of the board of trustees of KAUST; Minister of Health Khaled Al-Falih, who is chairman of the board of Saudi Aramco; Minister of Education Ahmad Al-Issa; Minister of Islamic Affairs Sheikh Saleh Al-Asheikh; Municipal and Rural Affairs Minister Abdullatief Al-Asheikh; Social Affairs Minister Majed Al-Qasabi; and Minister of Transport Abdullah Al-Muqbil. The emir also toured the pavilions of the productive family exhibition.

Speaking in Thuwal at the event, Prince Khaled saluted the outstanding contributions of the late King Abdullah, and noted especially the significance of KAUST for the Kingdom and the world.●

2

3

1. صاحب السمو الملكي الأمير خالد الفيصل، مستشار خادم الحرمين الشريفين، أمير منطقة مكة المكرمة، و معالي وزير التعليم الدكتور أحمد العيسى يستمعان لشرح مفصل حول مشروعات ثول من قبل المهندس نظمي النصر نائب الرئيس التنفيذي.

2, 3. صاحب السمو الملكي الأمير خالد الفيصل، مستشار خادم الحرمين الشريفين أمير منطقة مكة المكرمة، اثناء زيارته الأخيرة للجامعة.

وأكد النعيمي أن خطة تطوير طويلة المدى لثول، وتلبية احتياجات بنيتها التحتية، وإيجاد فرص استثمار لأهلها، وفرص عمل لأبنائها، والحفاظ على تراثها وبيئتها وحياتها الفطرية، هي مجمل الأهداف التي شكلها فريق العمل عند وضعه اللبنة الأولى من لبنات برنامج تطوير ثول".

واستحضر معالي المهندس خالد الفالح، وزير الصحة رئيس مجلس إدارة شركة أرامكو السعودية، في بداية كلمته، مقالاً قديماً للأمير خالد الفيصل وقال الفالح: "لقد نُحتت في ذاكرتنا كلمة سموكم الكريم عند افتتاح جامعة الملك عبدالله للعلوم والتقنية عام 1431هـ ، حينما قلتم (العالم الأول على أرضنا... فماذا نحن فاعلون؟)، ومنذُ ذلك الحين لم يغادرْ تفكيرَنا حجمُ التحدي لبناءِ الحاضرِ والاستعدادِ للمستقبل".

واعتبر الفالح أن قصة ثول، هي بحق "تجسيدٌ مصغَّرٌ لقصة تنمية المملكة، التنميةِ الشاملةِ المتكاملة، التي تشملُ كلَّ أنحاء المملكة، إذ نجدُ معالمَها في مدنها الكبرى، بتحدياتِ حجمِها وكثافةِ سكانها، والقرى والهِجَرِ بتحديات توزُّعِها وترامي أطرافها. والمملكة، بحمدِ الله، تعيشُ هذه التنمية مدنًا اقتصاديةً وصناعيةً في قلبِها وفي شرقِها وغربِها وشمالِها وجنوبِها، لا نُغْفِلُ جزءًا منها لحساب جزءٍ آخر، ولا نحصر التنميةَ في مكانٍ دون آخر، فكلُّ شبرٍ من أرضِ الوطن، أينما كان، عزيزٌ وغالٍ علينا، نبنيه وننميه، وإذا تطلب الأمر نذود عنه بأرواحنا".وأكد الفاح أن المملكةُ يقودُها اليومَ من صَنَعَ نهضةَ عاصمتِها من قبل، ومن تمتد يدهُ الكريمةُ بالتطور والرقي إلى كل أنحائِها الآن، ويأخُذُ بها المجلسُ الأعلى للاقتصاد والتنمية، تحت رؤيةِ خادمِ الحرمينِ الشريفين، إلى تحقيق كل عناصر التنميةِ التي تحقق لها الازدهار، بإذن الله. ولا يقود إلى هذا الازدهار مثلُ المعرفةِ والتعليم. وما نراهُ في ثول يطمئنُنَا أنَّ عناصر العالم الأول قد وصلت إلى هنا"..

ثم عرضت جامعة الملك عبدالله فيديو مدته 12 دقيقة عنونته بـ "تطوير الإنسان وتنمية المكان" اختزلت فيه كل هذه مشروعات ثول.●

1

افتتح الأمير خالد الفيصل، مستشار خادم الحرمين الشريفين أمير منطقة مكة المكرمة، مؤخراً مشاريع تطوير بلدة ثول (87 كيلاً شمال محافظة جدة)، بحضور ستة وزراء هم معالي المهندس علي النعيمي وزير البترول والثروة المعدنية رئيس مجلس أمناء جامعة الملك عبدالله للعلوم والتقنية، معالي المهندس خالد الفالح وزير الصحة، معالي الدكتور أحمد العيسى وزير التعليم، معالي المهندس عبداللطيف آل الشيخ وزير الشؤون البلدية والقروية، معالي الدكتور ماجد القصبي وزير الشؤون الاجتماعية، ومعالي المهندس عبدالله المقبل وزير النقل.

وكان سمو الأمير خالد الفيصل قد وصل صباح أمس إلى جامعة الملك عبدالله للعلوم والتقنية واجتمع مع رئيسها وقياداتها وعلمائها ثم تفقد مرافقها قبل أن يذهب إلى ثول ليفتتح سبع مدارس للبنين والبنات ومجمعاً طبياً يحتوي على عيادات تخصصية و5 مساجد يتقدمها جامع عمر بن الخطاب الذي يتسع لــ 1500 مصل فضلاً عن مشاريع تصريف السيول وافتتاح منتزه ثول الحضاري الذي يحوي ملاعب أطفال وسوقاً تراثياً ومطاعم وقاعات احتفال ومساحات خضراء للتنزه.. وكل هذه المشروعات التي قامت جامعة الملك عبدالله للعلوم والتقنية بالتخطيط لها والإشراف عليها تم تنفيذها من خلال شركة أرامكو السعودية وعلى أعلى المستويات حداثة وجودة.

وقال الأمير خالد الفيصل في كلمته ”من الوفاء، يجب أن نتذكر الرجل الذي فكر وقرر ونفذ مشروع جامعة الملك عبدالله للعلوم والتقنية وهو خادم الحرمين الشريفين الملك عبدالله بن عبدالعزيز رحمه الله ذلك الرجل الذي لا يعرف المستحيل، ذلك الرجل الذي تشرفت بخدمته سنوات عديدة وتعلمت منه الكثير وأتذكر ذلك اليوم العظيم الذي افتتح فيه هذه الجامعة.. وأتذكر أنني كتبت مقالاً في صحيفة الوطن عنوانه العالم الأول في أرضنا فماذا نحن فاعلون وأتذكر أنني ذكرت كيف يمكن أن تتخطى جامعتنا أسوارها لتفيد المجتمع.. وشرحتُ له رحمه الله حالة ثول واقترحت تطويرها وتنميتها فقال للوزير علي النعيمي ادرسوا تطوير ثول ونفذوا وهاهي الثمرة التي نقطفها اليوم..

شكراً للملك عبدالله وشكراً للملك سلمان ومزيدا من التوفيق لرجاله في حكومته الرشيدة. ولا أصف لكم فرحتي بمشاريع ثول.. هذا المشروع الذي كان حلما بالنسبة لي ليس لأنه مستحيل ولكن لأنه مشروع نفذ على دراسة تحت إدارة واحدة وبإتقان وبسرعة مذهلة

توحدت الجهود فجاء الإنجاز الكامل، وتوحدت الإدارة فكان العمل سهلا وميسرا ومتقنا، هذا المشروع كنت أحلم أن يكون نموذجاً وقد أصبح المشروع أنموذجا فعلا

هل لنا ان نطبق هذا النموذج في محافظات خرى ؟

انني استحث همم اخواني الوزراء بأن يفكروا بتطبيق هذه الفكرة لأنها نجحت

فهل لنا أن نطبقها في باقي محافظات مكة المكرمة

لو استطعنا أن ننفذ هذا النموذج في كل محافظة، في رابغ والليث القنفدة وفي أضم، طربة، رنية، الخرمة، بحرة والجموم .. نستطيع ان نبني هذا الانموذج بأقل التكاليف الممكنة

كل ما علينا أن نجعل في كل مخطط مستشفى ومجمع صحي وملاعب ومركز اجتماعي وغيرها من المنشآت واختتم قولي بأنه ليس هناك محال إذا أخلصت النوايا والأعمال”..

معرض الأسر المنتجة

وكان سمو الأمير خالد قد تجول في معرض الأسر المنتجة ثم توجه إلى المركز الحضاري واستمع إلى شرح مفصل من الوزراء عن كل مشروع وشاهدها أي المشاريع على الطبيعة..

ونظمت جامعة الملك عبدالله للعلوم والتقنية حفلاً كبيراً بهذه المناسبة في قاعة المناسبات الكبرى في المركز الحضاري بثول، وألقى معالي المهندس علي النعيمي وزير البترول والثروة المعدنية، رئيس مجلس أمناء جامعة الملك عبدالله كلمة الجامعة أوضح فيها أن استراتيجية هذه المشروعات التطويرية، بنيت على جملة أهداف، تأخذ في الاعتبار تجاور الجامعة والمجتمع المحلي الذي يحيط بها، بحيث يمكن تطوير وتكوين بيئة عمل وحياة كريمة، تقوم على تبادل المنافع، وتوفر فرص التنمية المستدامة للمنطقة، التي تنعكس فوائدها على الطرفين: الجامعة والمجتمع. كما أن جامعة الملك عبدالله للعلوم والتقنية تبنت منذ إنشائها عدداً من برامج المسؤولية الاجتماعية في ثول والتي تهدف إلى تطوير الإنسان وتنميته كهدف أساسي بل ومن أحد أهم أهداف الجامعة”.